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SCIENCE

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CHANDLER: THE TEACHER AND THE CHEMIST[1]

THE history of Charles Frederick Chandler's life is an essential part of the history of chemistry and chemical engineering in the United States during the last sixty years. In the early fifties, when young Chandler entered the Lawrence Scientific School at Harvard, chemical science in England and in this country was practically a monopoly of the druggists. Those were the days when the druggists in England were called chemists, and the name has persisted down to the present day. Young Chandler had to leave the Lawrence Scientific School and go to Professor Woehler, of Göttingen, in order to study the science of chemistry. Neither Harvard nor any other college in the United States was equipped in those days for training students in chemistry. When Chandler returned in 1857, decorated with a Göttingen Ph.D. degree, nobody seemed anxious to engage his services. He finally found some odd jobs with the oil men of New Bedford, analyzing their whale oil. His old friend, Professor Joy, of Union College, needed his assistance in the college laboratory, but the trustees were unwilling to appropriate a salary for an assistant in chemistry after they had appropriated five hundred dollars for a janitor of the chemical laboratory. The young doctor of philosophy took the vacant position of janitor. The privilege of giving scientific assistance to the professor of chemistry attracted him to the position of janitor. Nothing can describe better the state of the chemical science in this country in those days than this beginning of Chandler's scientific career. Nothing can describe better the latent energy of the young doctor of chemistry than his willingness to start his career as a janitor.

Who can tell to-day how long Chandler would have had to stay as janitor at Union College, if Professor Joy had not been called to Columbia College in 1857? But Joy stepped out of Union College and the trustees advanced Chandler from janitor to professor. Chandler's biography, entitled "From Janitor to Professor," would furnish a story of eminent value to the history of American science. Chandler soon outgrew his position at Union College and joined his old friend Professor Joy at Columbia College, where

[1] Address delivered at a Memorial Meeting, November 16, 1925, in honor of the late Charles Frederick Chandler.

with Eggleston and Vinton he started an enterprise which is unique in the history of engineering education in this country. They started the School of Mines of Columbia College, with no salary and no financial assistance from the trustees. Chandler was less than thirty when he became dean of the new school. The trustees of Columbia College were the typical college trustees of those days: lawyers, clergymen and gentlemen of leisure. The conservatism of men of that type would have hardly countenanced the venture of Chandler, Eggleston and Vinton, if Barnard had not been elected in that very year president of Columbia College. To them the venture would have looked very much like an adventure. But Barnard, although a Reverend, was one of those American scientists of vision who at the end of the Civil War started the new movement for higher endeavor in all our intellectual activities. Joseph Henry, John Draper, Barnard and Andrew White were the prophets of the new movement, which needed young apostles full of action, enthusiasm, training, and discipline. No young scientist in those days was better qualified than Chandler to preach the gospel of salvation which science promised to those who believed in it. Chandler became the apostle of the Chemical Science in the City of New York. One who knows the history of this apostolic mission can not help seeing a striking similarity between Chandler's scientific activity in the American metropolis fifty years ago, and the apostolic mission of St. Paul in Athens and of St. Peter in Rome. The mental attitude of the New York alderman and politician of fifty years ago was not a bit more kindly disposed to the gospel of science than the mental attitude of the Roman politician was to the gospel of Christianity. If American democracy had permitted it Chandler would have shared the fate of St. Peter. But fortunately there were in those days men in high places like Dr. Harris, of the Board of Health, and the Mayors Havemeyer and Ely who were converted by Chandler's gospel of science. His study of and report upon the sanitary problems of the city of New York opened their eyes. Chandler became the consulting chemist of the Board of Health and in 1873 its president. By reappointment he continued in presidential authority until 1883. During this period of ten years Chandler created the science of Sanitary Engineering and the science of nursing and public health and demonstrated their power in protecting the health and the life of the metropolitan population.

No belief is stronger to-day in the hearts of scientific men and engineers than the belief that in a democracy like our democracy science and engineering must form an essential part of our national government, and that the leaders of our scientific activities must be in closest contact with our national problems. Chandler was one of the earliest apostles of this belief, and he preached its gospel not only to the politicians but also to the captains of industries. Fifty years ago the mental attitude of the New York captains of industries with regard to science was just as hostile as that of the New York aldermen. They were all from Missouri and wanted to be shown, and it required the discipline, the enthusiasm, the courage and the inexhaustible energy of a Chandler to do the showing. He won them all and they ultimately became his friends and admirers. One of our greatest national assets to-day is the wonderful cooperation between American science and American industries; Chandler was one of the earliest advocates of this cooperation. His official position as president of the Board of Health of New York compelled him often to demonstrate before the courts that a metropolitan chemical industry which refuses to grasp the guiding hand of science is destined to become a public nuisance. The advocate of a good cause who is not too proud to fight is bound to win. Chandler was never too proud to fight for the cause of science, and he won many legal victories for the claims of science in the municipal administration of New York.

During my earliest student days at Columbia I was devoted to modern and classical literatures, to physics and mathematics. The science of chemistry had no fascination for me. It was in my untutored opinion, too sloppy, too wet and too empirical. The chemical laboratory, I thought, looked like a drug store or a dispensary, and smelt like a hospital. But one day I heard of Chandler's lectures and I made up my mind to try them. I tried them, and I became one of Chandler's boys during the remainder of my college career. Later, when he and I had become colleagues, I told him that he never met a New York alderman of fifty years ago who had a smaller knowledge of chemistry and larger prejudice against it than I had when as a sophomore of Columbia College I first entered his lecture room. "Then how in the world," asked Chandler, "did I manage to draw you away even temporarily from the ethereal heights of Homer, Shakespeare, Newton and Faraday and induce you to listen to my prosy language of chemistry?"

But Chandler's language of chemistry was never prosy. It was a thrilling epic which Chandler recited when, for instance, he described the wandering of the carbon atoms from the carbon dioxide of the atmosphere. One could see them glide along the beams of golden sunlight and plunge into the loving

arms of chlorophyl after bidding goodbye to their deserted oxygen partners. The wanderings of Ulysses as described by Homer are a prosy tale when compared with the wanderings of the carbon atoms through the labyrinths of organic life, in the vegetable and animal kingdom, to appear again in the busy stream of the living blood where they meet their former partners, the deserted oxygen atoms, and unite with them for a honeymoon of blissful idleness. Oxygen and carbon atoms no longer appeared to me like mere symbolic entities carrying on their backs, like state prisoners, a mysterious number, which told me nothing beyond the meaningless tale of their atomic weight. Chandler's epic revealed them to me as my most precious personal friends who toiled day and night in order to keep me alive. There was not one among the many chemical elements which did not play a leading part in some of Chandler's epics of chemistry, which he recited with matchless art. It is no wonder that students flocked to the School of Mines, the School of Pharmacy, and to the College of Physicians and Surgeons, in order to enlist in the ranks of Chandler's boys.

M. I. PUPIN

COLUMBIA UNIVERSITY

CHANDLER AND THE COLUMBIA SCHOOL OF MINES[1]

IN this memorial meeting an appropriate subject is "Chandler and the School of Mines" because the life of Professor Chandler was chiefly lived in the School of Mines of Columbia College and its outgrowths in Columbia University, and it may justly be said that his life has formed a larger part of the School of Mines than any other one of the many lives that have been given to its service.

Many in this audience have been privileged to hear Professor Chandler tell the brave story of the foundation of the School of Mines; how the plan of a School of Mines sprang complete from the brain of Thomas Egleston, a graduate of Yale and the Ecole des Mines of Paris, set forth in the pamphlet printed in 1863, entitled "Plan for a School of Mines and Metallurgy in New York City," by Thomas Egleston. How the establishment of the school was proposed to Peter Cooper, the founder of Cooper Union, who declined it saying: "You are proposing a great deal of education for a small number of men while the aim of Cooper Union is to give a moderate amount of education for a large number of men." How finally certain trustees of Columbia College became interested. How fifteen other interested citizens were made associate members of a committee of the trustees of the School of Mines. How they contributed a small amount of money to fit up crude laboratories for twelve students in the basement of an old broom factory on university land. How Vinton, a West Pointer and classmate of Egleston at the Ecole des Mines, and Chandler joined themselves with Egleston to constitute the first members of the faculty, with salaries unstated and uncertain. How, to the surprise of all concerned, twenty-four students made their appearance on the opening day, the fifteenth of November, 1864.

The passing of Chandler leaves the story of the foundation of the School of Mines to the written record and to tradition. We can not hear it any more from the lips of a founder.

To understand the significance of the School of Mines at its foundation and the importance of Chandler to the young school as well as the importance of the young school to Chandler, it is necessary to picture, in 1864, a condition of affairs with respect to scientific and technical education as different from that which exists the country over to-day as the Columbia College of that day with its 157 students is different from Columbia University in the City of New York to-day.

The Rensselaer Polytechnic Institute had been founded in 1824 and had become a school of civil engineering. That school together with the West Point Military Academy, some two hundred of whose students entered engineering before 1860, had furnished most of the engineering graduates of the country, five or six hundred in all.

In 1847 scientific schools had sprung up under pretty distinct disapproval of the academic faculties at Harvard and Yale and became the Lawrence Scientific and Sheffield Scientific Schools, respectively. However, they had few graduates and were struggling. At one state university, namely, the University of Michigan, a course in civil engineering was established in 1847, but there were no graduates until 1861.

While before 1864 there were only the four schools just referred to offering a definite curriculum in scientific and technical studies, there had been widespread agitation on the subject of scientific and technical schools, and in 1862 Congress had passed the Morrill Act setting aside public lands for the support of schools of agriculture and the mechanic arts.

In the general readjustment of views consequent upon the turmoil of the Civil War, the necessity for the application of science to the service of the growing industries of the country was becoming understood. It was at such a time that Egleston brought forward his proposal of his School of Mines and

[1] Address delivered at the memorial meeting in honor of the late Professor Charles Frederick Chandler, Havemeyer Hall, Columbia University, November 16, 1925.

Metallurgy, not to be located at the mouths of mines or beside great blast furnaces and smelters where the students should daily see the toiling practice of the mine and the furnace, but a School of Mines to be located in a great city, a center of science, of education and of human intercourse in all the affairs of civilization.

The result was one to be expected. The new enterprise drew to itself as professors and as students men of the type that strike out for themselves, that venture where others would be timid, that defy educational conventions where these conventions have become confining. After Vinton, who was an old acquaintance and classmate of Egleston, Chandler was the first of these men to come to the new school.

Equipped with the best training of the German universities, he had, at the age of twenty-eight, already occupied the chair of chemistry at Union College for seven years with great success. Looking back at Chandler's life, it is easy for us to picture how the new School of Mines appealed to him.

This was to be a school in which science was not to occupy a secondary or subordinate place, but was to be made the basis of the curriculum. A school, therefore, in which his own science of chemistry would have the fullest chance for development. We know how he loved and magnified that science. Furthermore, the new school was to be in a great city where the opportunities for public service would be unlimited, and you have heard this evening how he rose to those opportunities. Therefore it was only natural that Chandler, regardless of what pay he might receive, decided to throw himself into the work of the new school.

It is sufficient to say that there was probably not a man in the country better qualified in ability and training to occupy a professorship of chemistry than young Chandler.

To sketch the development from that early School of Mines would take too long, but before Chandler retired in 1910 it had grown into the School of Mines, Engineering and Chemistry with a faculty of fifty-one professors and numerous junior instructors, offering degrees in mining engineering, metallurgical engineering, civil engineering, electrical engineering, mechanical engineering, chemical engineering and chemistry with an attendance of 516 students.

The graduates up to 1910, practically every one of whom had received instruction from Chandler in chemistry, numbered 2,271. In mining, engineering and metallurgy particularly they had occupied a predominant place in the profession for many years.

It was always the opinion of Professor Chandler that the success of the School of Mines was due to the fact that from the first the curriculum broke completely away from the college curriculum and offered strictly a professional education. In his own words, he says:

"Professor Egleston's idea, with which President Barnard, General Vinton and myself fully concurred, was that the course of study in the new School of Mines should be purely professional and that no matter how desirable a subject might be to an educated man, if it were not professional or necessary to the profession, it must be acquired outside of the new School of Mines, as we felt that we needed all the time at our disposal to give a man a thorough professional education as a mining engineer, a chemist, or as any other professional scientist.

"It was on this plan that the opening of the School of Mines was announced, and it is on this plan that it has been conducted for the past forty-six years as is also true of each of the other courses of engineering under the direction of the faculty of applied science.

"This is the real secret of the success of Professor Egleston's plan. Our Schools of Mines, Engineering and Chemistry stand by the side of the Law School and the Medical School as purely professional schools."

To the public, on account of his many public lectures and his distinctive service in public office, Chandler, more than any other professor, typified the School of Mines as a place where scientific training was combined with practical resourcefulness and devotion to the public good.

To his colleagues in the School of Mines, Chandler was a friend ever ready with his help in any situation. In the deliberations of the faculty he was a master in convincing debate. A well remembered incident is of the time when he desired to have more mathematics taught in the curriculum for chemists and the head of the department of mathematics was opposed.

Professor Chandler appeared at the faculty meeting with an arm full of books which he spread out on the table with pages marked and when the question came up for discussion, he pointed to the books, and said: "There, gentlemen, are important articles in chemistry which I can not read because I do not have enough mathematics. We do not want our students to be in my predicament." The desired mathematics was added to the curriculum.

To his students, those thousands whom he called "my boys," he was the teacher who could with apt illustration or with witty account make a fact or principle impossible to forget. In his enthusiastic love of his science he never slackened in trying to communicate his understanding of the greatness of chemistry and its significance in life; an ever-approachable elder brother.

As dean of the School of Mines for thirty-three years from its foundation, Chandler must have had to

administer discipline, but one never hears of that. We can not think of him as a strict disciplinarian. We can only think of him as the man who would always help to set a student right.

His help was not limited to advice, but often took his pen to his check book. One of his colleagues happened in his office one day as Professor Chandler was opening a letter. A check fluttered out and when it was handed back, Professor Chandler said: "Do you know what this is? It is a return of $500 from a student whom I was able to help when he was in college." But Chandler made few remarks about this kind of thing.

In Columbia University the specialized advanced or graduate work in the departments of chemistry and of geology and mineralogy, and, to somewhat less extent, in the department of physics, grew directly out of the School of Mines. In the department of chemistry, Chandler was always eager to provide facilities for the most advanced work in the subject.

His influence had much to do with the gifts from the Havemeyer family that erected this building. When the trustees seemed unable to find money for some of the equipment of this building when new, Chandler quietly paid out $5,000 of his own money for apparatus that he thought the department needed. When a worthy citizen of New York came to make his will, he let Professor Chandler write it for him and Columbia University as the legatee of Mr. Stephen Whitney Phoenix has received a great fund to provide that no equipment should be lacking in physics and chemistry for purposes of instruction and research.

The department of chemistry at Columbia under the guidance of Professor Chandler was one of the first in the country to recognize the importance of organic chemistry as a special branch of chemistry by the appointment of an officer of professorial grade in this branch of the subject. Again, it was one of the first departments to bring to its staff one of that small but important group of young men trained in German universities in the early development of physical chemistry who became the pioneers in that subject in this country.

Upon his retirement in 1910 a final act of devotion to his science in this university was the gift of his incomparable museum of chemistry, now known as the Chandler Museum.

The School of Mines has its Professor Chandler for always and shares him with the whole of this university, with this city in which he lived, with industry which he promoted in many ways and with the whole chemical profession. His deeds kept in memory will lead others his way.

GEORGE B. PEGRAM

SCIENTIFIC EVENTS

THE SCIENCE EXHIBITION AT THE KANSAS CITY MEETING OF THE AMERICAN ASSOCIATION

As has already been announced (SCIENCE for November 27, page 475), a new departure is being made this year by the American Association for the Advancement of Science. For the Kansas City meeting of December 28 to January 2 the science exhibition is being planned on a much larger, more interesting and useful scale than has ever been attempted before at a convention of the association. Arrangements for this are in the hands of Major H. S. Kimberly, of Washington, D. C., director of the Kansas City Exhibition, and Mr. Albert Saeger, of the Kansas City Junior College, is chairman of the local subcommittee on the exhibition. The exhibits are to be housed in the Aladdin Hotel, newly opened to the public, and there will be ample space and facilities for excellent displays.

Exhibitions have been held in connection with earlier meetings of the association, notably at New York in 1916, at Toronto in 1921, at Cincinnati in 1923, and at Washington in 1924, and the scope and importance of this feature have been widened and increased in recent years. The idea is before us that the annual exhibition of the association may become progressively of greater use and consequence to the advancement of science in America. The enlargements and improvements to be instituted at Kansas City will be in that direction.

There seems to be no question that American makers and distributors of scientific apparatus and materials and American publishers of scientific books will continue to welcome and support the annual science exhibition as an excellent means for bringing their products to the attention of professional scientists and the public at large. The general program of the meeting will include advertising this year and it is hoped that many firms that take space in the exhibition will also insert their notices in the program, which may thus be not only the very good outline of American scientific progress that it has been in recent years, but also a convenient and valuable directory of manufacturers, distributors and publishers.

But the most needed improvement in our science exhibition is with regard to the part devoted to exhibits by individual research workers and research laboratories and institutions. While recent exhibitions have shown a considerable and steady advance in this respect, very much still remains to be accomplished. An effort is being made this year to secure

more non-commercial exhibits than have been entered before, and all scientists and institutions that can possibly do so are urged to take part. What is mainly needed is exhibits of newly devised or improved methods for research, either in the form of operating apparatus or otherwise, as by means of models, drawings or photographs, and exhibits of new results of research. Members of the association or of the associated scientific organizations are earnestly requested to do their share toward making the Kansas City Exhibition the great success that it surely ought to be.

Members are also asked to aid the exhibition management to secure exhibits and advertising from commercial firms. A small charge will be made for space taken by these firms, but no charge will be made in case of exhibits from individuals and research laboratories. Correspondence should be addressed to Major H. S. Kimberly, director of the Kansas City Exhibit of the American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D. C. Prompt action is very requisite; only a little time remains.

HOTELS AT THE KANSAS CITY MEETING

To the list of hotels already published in SCIENCE (November 13) are to be added the following names. All these hotels are within a block or two of those already mentioned.

The Aladdin Hotel. Single rooms, $2.50 and up; double rooms, $3.50 and up. All rooms have baths. The registration and publicity offices will be in the Aladdin and the upper floors are reserved for the exhibition. It is a new hotel, just being opened.

The Commonwealth Hotel. Single rooms, $2.00 and $2.50; double rooms $3.00 and $3.50. Each room is with bath.

The Robert E. Lee Hotel. Single rooms $2.00 and $2.50; double rooms $3.00 and $3.50. All are outside rooms and all have baths.

As in case of the other hotels on our list for the Kansas City meeting, room reservations should be sent directly to the hotels. Promptness in applying for reservations may avoid possible slight troubles upon arrival in Kansas City, but there seems to be no question as to the adequacy of the hotel accommodations for the meeting.

BURTON E. LIVINGSTON,
Permanent Secretary

MEETINGS OF THE SECTION OF ZOOLOGY AT KANSAS CITY

A COMPLETE program is being arranged for Section F at Kansas City to cover three days, Tuesday, December 29, to Thursday, December 31. On Tuesday afternoon the retiring vice-president, Dr. Edwin Linton, will deliver his address on the topic of "The scientific method and authority." At the same session Dr. C. E. McClung will also address the section on "A quarter-century of American cytology." Both addresses are open to the public.

On Tuesday morning, and on both the morning and the afternoon of Wednesday, sessions will be held for the reading of papers by members of the section. It may be necessary to hold similar sessions on Thursday. A joint session with the Society of Parasitologists is scheduled for Thursday morning and a joint session with the Ecological Society of America for Thursday afternoon. A meeting of the section committee is called for Tuesday afternoon following the public addresses, and the business meeting of the section will occur at 9:30 on Wednesday morning. The zoological dinner will take place on Wednesday evening at the headquarters of the section.

The headquarters for Section F and the zoological societies will be the Kansas City Athletic Club, 11th Street and Baltimore Avenue. Members should make their reservations early and directly with the Athletic Club. The secretary of the local committee announces that rooms for women may also be had at the Athletic Club during the time of the meetings.

For information on railroad rates, other hotels and general announcements members should consult the preliminary announcement of the permanent secretary of the association, which has been published in SCIENCE for November 27. A list of hotels and rates were also published in SCIENCE for November 13.

GEO. T. HARGITT,
Secretary of Section F

SYRACUSE UNIVERSITY

GRANTS OF THE CARNEGIE CORPORATION

IN view of its financial position, the Carnegie Corporation has continued during the fiscal year just closed a policy of holding down its grants to a minimum figure, according to the announcement made by President F. P. Keppel in submitting his yearly report to the trustees of the corporation at the annual meeting of the board in New York. With a single exception, the grants voted during the year ending September 30, 1925, come to an even smaller total than those made during the previous year, namely, $2,408,645, as against $3,206,115.95. The single exception referred to is that of the Carnegie Institution of Washington, which was voted $5,712,500, of which $5,000,000 will be an addition to its capital endowment. The total of grants authorized for the year by the trustees of the corporation is therefore $8,121,145.

In describing the grant made to the Carnegie Institution of Washington, Mr. Keppel said:

The duty of the corporation is clearly to give careful consideration to any proposal which may be received from a sister institution, but to take favorable action only as it is convinced that the grant proposed, as compared with other possibilities of usefulness open to the corporation, offers an outstanding opportunity to carry out the broad terms of its charter. To the trustees of the corporation it appeared that the situation facing the Carnegie Institution of Washington did offer such an outstanding opportunity and it appeared further that a delay in coming to the aid of the institution until a day more convenient from the point of view of its own finances would involve serious injustice to a body of workers whose contributions to science and scholarship are of the greatest importance to the community.

In view of its action in making this grant, the corporation has made a re-study of its whole financial situation and has now before it a seven-year program, which, if carried out, will: (1) meet the stated obligations falling within the period; (2) liquidate in full the grants upon which interest is now being paid pending capitalization; (3) restore its reserve fund to its normal figure of $2,500,000; (4) continue the amortization of its $8,000,000 grant to the Carnegie Institute of Pittsburgh, due in 1946, and (5) provide a limited sum, estimated at $2,225,000 annually, for the continuation and development of its own program.

The program of the corporation, for the present, is concentrated upon adult education, library service and the arts and upon selected educational studies and cooperative research problems.

TESTIMONIAL TO DR. JAMES F. NORRIS

PRESIDENT JAMES F. NORRIS, of the American Chemical Society, was honored by the Northeastern section of the society in Boston on the evening of November 13, when as guest of the section he was tendered a banquet and reception and then, after he had delivered an address to the members of the section and their guests, was presented with an engrossed testimonial of appreciation for his services as president of the society.

Mr. Norris, a member of the faculty of the Massachusetts Institute of Technology, where the testimonial meeting was held, is a member of the Northeastern section as well as president of the national society. Last year as chairman of the division of chemistry of the National Research Council he traveled all over the United States enlisting the cooperation of manufacturing chemists in the council plan to foster chemical research. Last summer he spent traveling in Europe and received numerous honors.

Although it is not customary for a president of the American Chemical Society to succeed himself, in recognition of Professor Norris's able administration the Northeastern Section of the society has voted to nominate him for reelection.

The illuminated testimonial was presented Professor Norris by Professor Lyman C. Newell, chairman of the section and head of the chemistry department at the Boston University College of Liberal Arts, on behalf of the section. The ceremonies were held in connection with the regular meeting of the section held at Massachusetts Institute of Technology. A reception to Professor Norris was given in Walker Memorial building at 6 P. M., followed by an informal dinner in North Hall, Walker Memorial, at 6.30 P. M. Following the dinner Professor Norris spoke briefly on his experiences last summer in traveling in Europe on behalf of the organization.

The meeting itself was convened at 8 P. M. in the naval architecture building, where Professor Norris was the speaker of the evening. His subject was "Chemical Reactivity."

As his address drew to a close, Professor Newell arose and paid tribute to Professor Norris's services to the society, to the cause of education and to the cause of chemical research, as well as to his eminence as a scientist. Then he presented the engrossed tribute. The gift, a booklet bound in a crushed Levant leather case, blue in color, with a hand-tooled special design, gold ornamented on the margin, contained the tribute of the section, and was signed by the officers of the Northeastern Section, headed by Professor Newell as chairman, and by about 250 members of the section, resident in and near Boston. The pages are illuminated by hand, and are in two colors. The text of the tribute is as follows:

We, your associates and friends in the Northeastern Section of the American Chemical Society, desire at this time to express our genuine appreciation of your achievements as an executive, organizer, investigator, teacher and author in the field of chemistry.

We recognize that your work in the varied phases of chemistry has been characterized continuously by marked originality, keen insight, unerring judgment and prodigious industry.

We are gratified that your contributions to chemistry and your cordial cooperation with chemists have brought honor to you at home and abroad.

We rejoice in your pervasive geniality and in your ability to establish and maintain friendship.

We wish sincerely that the springtime of youth may always stay in your heart during the coming years of still greater achievements.

SCIENTIFIC NOTES AND NEWS

THE following awards have been made by the Royal Society: The Copley Medal to Professor Albert Einstein, for his theory of relativity and his contributions to the quantum theory; the Davy Medal to Sir James Irvine, for his work on the constitution of the sugars; the Sylvester Medal to Professor A. N. Whitehead, for his researches on the foundations of mathematics; the Hughes Medal to Mr. F. E. Smith, for his determination of fundamental electrical units and for researches in technical electricity; the Royal Medals to Professor W. H. Perkin, for his work on the constitution of the alkaloids, and to Professor A. C. Seward, for his researches on the paleobotany of Gondwanaland.

THE following officers were elected at the anniversary meeting of the Royal Society on November 30: *President,* Sir Ernest Rutherford; *treasurer,* Sir David Prain; *secretaries,* Mr. J. H. Jeans and Dr. H. H. Dale; *foreign secretary,* Sir Richard Glazebrook. *Other members of council,* Professor J. H. Ashworth, Professor L. Bairstow, Professor F. O. Bower, Professor S. Chapman, Sir Dugald Clerk, Professor F. G. Donnan, Professor E. J. Garwood, Professor J. P. Hill, Professor J. B. Leathes, Professor J. C. G. Ledingham, Sir Thomas Lewis, Professor F. A. Lindemann, Sir Robert Robertson, Sir Charles Sherrington, Dr. G. C. Simpson and Mr. W. C. D. Whetham.

DR. JOHN J. ABEL, professor of pharmacology at the Johns Hopkins Medical School, will receive the first $2,500 annual award of the Research Corporation of New York, as an investigator who has made "outstanding contributions to the cause of science without profit to himself."

THE Perkin Medal for 1925 has been awarded to Dr. R. B. Moore, formerly chief chemist of the U. S. Bureau of Mines, who was largely responsible for the development of helium production during the war. The medal is given by the American section of the Society for Chemical Industry and the selection is made by a committee from that organization, the American Chemical Society, the American Institute of Chemical Engineers and the American section of the Société de Chimie Industrielle. The presentation will be made on January 15.

DR. EDWARD ROBIE BERRY, of the General Electric Company, Lynn, Mass., has been awarded the Grasselli Medal of the American section of the Society of Chemical Industry. Presentation of the medal will be made at a meeting of the section in New York City on December 4, when Dr. Allen Robers, of the Pratt Institute, will give reminiscences of Dr. Berry's early days, and Professor Robert W. Wood, of the Johns Hopkins University, will speak on the optical properties of fused quartz and its use in the study of ultraviolet light.

PROFESSOR CHARLES L. THORNBERG, professor emeritus of mathematics at Lehigh University, was awarded the honorary LL.D. by the university on the occasion of its annual founder's-day exercises.

DR. GEORGE H. MEEKER, dean of the graduate school of medicine of the University of Pennsylvania, received the degree of doctor of laws from Lafayette College at the founder's day exercises on October 21.

DR. J. FRANK DANIEL, professor of zoology at the University of California, while on sabbatical leave last year, attended the meetings of, and was elected to membership in the Société Zoologique de France, which met at Paris, and in the Association des Anatomistes, which met at Turin.

PROFESSOR DAVID EUGENE SMITH is preparing to retire from his active work as professor of mathematics in Teachers College, Columbia University, on February 1. He expects to devote his attention thereafter to writing. Lectures on the history of mathematics at Columbia will be discontinued with his retirement.

DR. KARL FROMME, professor of theoretical physics and geodesy at the University of Giessen, retired on November 1.

THE Bakelite Corporation has established a research fellowship in the research division in the School of Chemistry and Physics at the Pennsylvania State College. Dr. Lyman Chalkley, Jr., formerly research chemist of the Standard Oil Company, Whiting, Ind., has been appointed as senior fellow.

DR. H. L. DOZIER, chief of the division of entomology of the Porto Rico Insular Station, has been appointed entomologist at the Delaware Experiment Station.

THE Pharmaceutical Society of Great Britain has appointed Dr. J. H. Burn, pharmacologist in the National Institute for Medical Research, director of the new laboratories to be established by the society to provide facilities for biological tests such as are imposed under the therapeutic substances act, which became law on August 7, 1925.

DR. E. W. SCHULTZ, M. D. (Hopkins, '17), has received a fellowship from the John Simon Guggenheim Memorial Foundation. Dr. Schultz will work on the bacteriophage, in the laboratory of the International Sanitary Council at Alexandria, Egypt.

PROFESSOR H. H. WHETZEL, of Cornell University, and Dr. F. J. Seaver, of the New York Botanical Garden, will sail early in January for a five-weeks

collecting trip in Bermuda. They are preparing a fungous flora of these islands for the Bermuda government. They will be the guests of the director of agriculture, Mr. E. A. McCallan.

DR. C. P. RICHTER and Dr. G. B. Wislocki, of the Johns Hopkins University, have returned from Central America where they studied tropical animal life. Most of their time was spent at the Institute for Research in Tropical America.

DR. S. F. BLAKE, of the U. S. Bureau of Plant Industry, returned from abroad in November, where he has been examining types of South American Compositae at the principal European herbaria.

PROFESSOR PAVLOV, the Russian physiologist, has left Leningrad for Paris, where he intends to work in the Sorbonne for some time.

DR. JAMES F. NORRIS, president of the American Chemical Society, is visiting a number of cities from November 17 to December 15, during which period he will give addresses before about twenty meetings of local sections of the American Chemical Society.

DR. EDWIN E. SLOSSON, director of Science Service, will address the Columbia University chapter of the Sigma Xi on December 8 on "A chemical interpretation of history."

ON November 13, in connection with his visit to the Illinois Geological Survey at Urbana, Ill., Dr. David White, chairman of the division of geology and geography of the National Research Council, spoke before a joint seminar meeting of the staffs of the survey and the department of geology of the University of Illinois on "Lines of geologic investigation of especial promise."

DR. CHARLES R. STOCKARD, professor of anatomy at the Cornell University Medical College, gave, on November 17, the second annual lecture of the Biochemical Society of the Jefferson Medical College, Philadelphia, on "Recent advances in our knowledge of internal secretion." Professor H. Gideon Wells, of the University of Chicago, is announced as the third lecturer for 1926.

DR. IRVING LANGMUIR, of the Research Laboratory of the General Electric Company, Schenectady, gave an address on "Pure science in industrial research," at the Faculty Club of New York University, on November 20.

PROFESSOR JAMES KENDALL, of the department of chemistry of Columbia University, delivered his retiring address as chairman of the New York section of the American Chemical Society at the November meeting of the section at the Chemists' Club on November 6. The subject of his lecture was: "The separation of the rare earths."

HARALD U. SVERDRUP, in charge of the scientific work of the *Maud* expedition to the Arctic, gave an illustrated lecture on the scientific work of the expedition at the Carnegie Institution of Washington, on December 1.

DR. ANNIE J. CANNON, of the Harvard College Observatory, will give an illustrated lecture on "Starlight and its message," before a meeting of the American Philosophical Society, in Philadelphia, on December 4.

DR. LIBERTY HYDE BAILEY, of Cornell University, gave a lecture on "Botanical gardens," before a meeting of the Ohio Botanic Garden Society, which met in Cincinnati, on November 20.

MISS H. NEWELL WARDLE, assistant curator of the Academy of Natural Sciences of Philadelphia, on November 19 addressed a meeting of the Philadelphia Natural History Society on the "Life of the eastern woodland Indians before the discovery of America."

PROFESSOR YANDELL HENDERSON, of Yale University, lectured at the Royal Society of Medicine, London, on October 22 and 23 on "The control of respiration in anesthesia by inhalation of carbon dioxide and on absorption and elimination of volatile substances through the lungs." The lectures were repeated at the University of Manchester on October 26 and 27, and at the University of Edinburgh on October 29 and 30. They were delivered under the auspices of the Dental Board of the United Kingdom. On November 30 and December 1 Professor Henderson lectured at University College, London, on the "Efficiency of the heart, and its measurement."

DR. ALBERT SAUVEUR, professor of metallurgy and metallography of the Harvard Engineering School, gave a series of three public lectures on November 30, December 1 and 2 at the Carnegie Institute of Technology on "Directional properties and dendritic segregation in steel" and "Hardening of steel."

DE LAMAR lectures at the Johns Hopkins University have been given as follows: November 16, by Dr. David Marine, "The prevention of simple goiter as a public health problem"; November 30, by Dr. Alice Hamilton, "The present status of industrial toxicology in the United States."

THE Huxley memorial lecture before the Royal Anthropological Institute was given this year by Sir Arthur J. Evans, F.R.S., at the rooms of the Royal Society, November 24, on the subject of "Early Nilotic, Libyan and Egyptian relations with Minoan Crete."

THE hundredth annual course of Christmas lectures for children at the Royal Institution will be delivered this year by Sir William Bragg on "Old trades and new knowledge." The trade of the sailor is the title of the first lecture, to be given on December 29, and the following five lectures will be on the trades of the smith, the weaver, the dyer, the potter and the miner.

PROFESSOR E. P. CATHCART delivered the Chadwick public lectures at Reading, England, on October 30 and 31, his subject being the nature and composition of food and its relation to the energy needs of the body.

SIR DAVID PRAIN, F.R.S., formerly director of Kew Gardens and of the Botanical Survey of India, gave a lecture on some useful plants of India at a meeting of the Pharmaceutical Society of Great Britain on November 10.

IN memory of Dr. Norman Lothian (British) and Dr. Darling (American), the two members of the Malaria Commission of the League of Nations who were killed in a motor accident near Beirut last May while investigating malaria conditions in Syria, the League's Health Committee has decided to create a "Lothian Scholarship" and a "Darling Prize," which will be awarded periodically for the encouragement of malariological study.

A MEMORIAL to Sir James Dewar, consisting of a bronze plaque, was unveiled at the Royal Institution of Great Britain on November 10.

DR. FREDERICK B. PECK, professor of mineralogy and geology at Lafayette College, died on November 2, aged sixty-five years.

DR. JOHN LEWIS HILDRETH, formerly professor of clinical medicine and dean of Tufts Medical College, Boston, died on November 27, in his eighty-seventh year.

PROFESSOR J. MASSART, professor of botany in the University of Brussels, has died, aged sixty years.

DR. PAUL HEGER, from 1873 to 1907 professor of physiology at the University of Brussels, and afterwards honorary professor and president of the university, has died, aged seventy-nine years.

DR. MORITZ RETHY, professor emeritus of mathematics at the Budapest School of Technology, has died at the age of seventy-nine years.

THE deaths are announced of Dr. Y. V. Samoilov, a Russian professor of mineralogy, and B. V. Davydov, hydrographist and leader of a number of expeditions to Wrangle Island.

THE president of the executive committee of the International Research Council has summoned a meeting of the general assembly of that body to be held at Brussels on June 29, 1926. The object of the meeting will be to discuss the advisability of removing from the statutes the restrictions which have hitherto stood in the way of admitting the Central Powers of Europe to the Research Council.

THE board of directors of the American Institute of Electrical Engineers has, on the recommendation of the committee on coordination of institute activities, adopted the following schedule of meetings for 1926: Midwinter convention, New York, week beginning February 8; annual business meeting, New York, May 21; annual convention, probably June 21-25, place to be determined by the committee; Pacific Coast convention, Salt Lake City, date to be decided later; regional meetings: Middle Eastern District, Cleveland, March 18–19; Northeastern District, Niagara Falls, latter part of May or early in June.

THE Biological Laboratory of the Long Island Biological Association at Cold Spring Harbor has recently acquired a forty-five foot motor launch. The boat, which is the gift of Dr. Walter B. James, a member of the board of directors of the biological laboratory, is capable of carrying sixty persons to marine collecting grounds in the vicinity of the laboratory. Its shallow draught of less than three feet will permit of its entering inlets and estuaries, while its seaworthiness, due to its 9½ foot beam and general construction, will make practicable collecting trips to the rocky Connecticut shore across the sound. It is equipped with a standard heavy duty marine motor, developing a speed of ten miles an hour. Apparatus, suitable for dredging in Cold Spring Harbor, Oyster Bay and Long Island Sound, will be installed.

A SHIPMENT consisting of seventy mammal skins and skulls has been received by the U. S. National Museum, collected by Dr. Hugh M. Smith, in Siam. These specimens make an important addition to the collection of mammals as they come from a region not represented in the collections of Malayan mammals previously made for the museum by Dr. W. L. Abott and C. B. Kloss.

A CORRESPONDENT writes: "L'Institut Océanographique, founded by the Prince of Monaco, had already published seven volumes of its *Annales* before the interruption caused by the breaking out of the European war. Since 1922, however, the publication of these *Annales* has been continued under the direction of Professor Joubin, of the Museum d'Histoire Naturelle, Paris. It has just been learned that there is scarcely an institution, library, museum or university in this country which has up to the present time

subscribed to these resumed *Annales* which, at the present state of foreign exchange, cost less than three dollars a volume. This lack of interest on the part of American scientists in the scientific work of this French institution is the more to be wondered at, since European countries on the economic footing of Austria, Russia and Germany have found the ways and means to resume their normal subscriptions for their learned institutions."

THE U. S. Public Health Service will make an extensive survey in Polk, Hillsborough and Citrus counties, Florida, of malaria. Headquarters of the investigation will be at Lakeland under the direction of Bruce Mayne, assistant technical engineer, who investigated the malaria situation in this community in 1917. The present survey will require several months.

UNIVERSITY AND EDUCATIONAL NOTES

NEW YORK UNIVERSITY has received a gift of $600,000 from the Nichols Foundation, Inc., established by Dr. William H. Nichols, which is to be used to erect a new chemistry building at University Heights. Chancellor Brown announced the members of the chemistry building committee as follows: General John J. Carty, Dr. W. H. Nichols, Professor A. E. Hill, Professor Collins P. Bliss and LeRoy E. Kimball.

THE late Miss Helen Culver has bequeathed $600,000 to the University of Chicago. According to the terms of the will this bequest is to be added to the Helen Culver Fund, founded in 1895.

THE General Education Board of the Rockefeller Foundation has made a gift of $350,000 for neurological teaching and research at Harvard University. This amount is to be added to the approximately similar amount employed by the university for this purpose and it is to be used in connection with the work at the Boston City Hospital as the new buildings there are developed. The work is to be under the charge of Dr. Stanley Cobb, professor of neurology in the university.

IT is announced that Princeton University within the next two years will expend a half-million dollars in the construction of a new engineering laboratory.

PROFESSOR WILLIAM D. FUNKHOUSER, head of the department of zoology at the University of Kentucky, has been made dean of the graduate school.

HAROLD J. BARRETT, instructor in chemistry at the Ohio State University, has been appointed assistant professor at the South Dakota State College.

THE Siamese government has recently completed negotiations for the appointment of Dr. Everett C. Albritton, of the department of physiology at the University of Buffalo, as professor of physiology at the Chulalongkorn University at Bangkok.

ASSOCIATE PROFESSOR W. L. MISER, of the Armour Institute of Technology, was recently appointed professor of mathematics at Vanderbilt University.

DR. FRIDJOF NANSEN, the Arctic explorer and Norwegian statesman, has been elected rector of the University of St. Andrews.

PROFESSOR RICHARD GANS, of the University of La Plata, has been appointed professor of physics at the University of Königsberg.

DISCUSSION AND CORRESPONDENCE

A NEW UNITED STATES WEED: HYMENOPHYSA PUBESCENS[1]

THE U. S. National Museum received recently for identification from Mrs. M. E. Soth, of Pocatello, Idaho, specimens of a cruciferous plant evidently not described in the manuals covering the Rocky Mountain region. The plant was determined from descriptions as *Hymenophysa pubescens* C. A. Mey., but since no herbarium material of the genus was available for comparison, a specimen was forwarded to the Berlin Botanic Garden, where Dr. O. E. Schulz confirmed the writer's tentative determination.

The genus *Hymenophysa* is reported to consist of three species, two of them described from Persia and Turkestan. *H. pubescens,* the original species, is a native of the Altai region of central Asia, where it grows in moist subsaline places on the desert plains. Concerning its occurrence at Pocatello, Mrs. Soth supplies the following information:

> The colony of this plant has increased greatly in extent and density since I discovered it two seasons ago. It occurs at the edge of a grain field which previously had been in alfalfa for several years. There has been so little cultivation of the area that the colony has not been disturbed very much, and has spread among the grass and weeds toward the ditch bank that borders the field, until it occupies a space about twelve by eighteen feet. The habit of the plant in shooting up flowering branches from the lower parts after the first fruits ripen makes it conspicuous at this season (September). I should not expect this colony to be eradicated easily by any ordinary process of tillage. My guess as to its origin would be that the seeds were mixed with those of alfalfa or possibly some sort of imported grain seed. I have found a few plants in other localities, to which seed probably was carried with hay from this field. I have no doubt that we are recording the first stages in the establishment of another weed that will be quite common in a few more seasons.

Hymenophysa pubescens is a perennial, but flowers the first year from seed. In general appearance and

[1] Published by permission of the Secretary of the Smithsonian Institution.

habit it is strongly suggestive of *Lepidium draba,* as noted by Meyer in his original description. It may be recognized by its erect habit; clasping-sagittate stem leaves, toothed and with a dense pubescence of fine simple hairs; the long racemes of small white flowers; and the small, globose and inflated, pubescent pods.

Coming from a region similar in climate to some parts of the western United States, this plant may become as widely established as certain other recent introductions. Another Old World plant of the same family, *Lepidium perfoliatum,* has spread with almost incredible rapidity through the Rocky Mountain states during the last few years.

PAUL C. STANDLEY

U. S. NATIONAL MUSEUM

THE PRIMARY FOODPLANT OF THE MELON APHID

A FACT known to those who are familiar with the habits of aphids is the seasonal migration of many species of these insects from their overwintering host plant to other vegetation which is colonized by the summer generations.

Certain species of aphids are of economic importance only while on their summer (or secondary) food plants, as would obviously be the case if their overwintering (or primary) host plant chanced to be a weed or vegetation of little economic value. Thus it happens that an aphid may be well known for its summer damage to important crops long before its overwintering habits have been discovered.

Such has been the history of the melon aphid (or the cotton aphid, as the same insect is also known in the south). This insect is a noted pest the world over, as it colonizes cotton, economic plants of the gourd family and certain other valuable annuals. It will accept, too, succulent, rapidly growing shoots of some shrubs and trees, and is recognized as one of the orange pests.

Since this insect does not deposit its overwintering eggs on any of these plants on which it is known as a summer pest, and since, in all parts of the country having cold winters, it would be impossible for such an aphid to overwinter without providing for an egg-stage somewhere, it has long been thought by entomologists that the melon aphid must be a migratory species existing during the winter in some unsuspected disguise.

But what plant it seeks for its winter quarters and from what plant it migrates each season when it is time for its summer depredations has remained a mystery.

It has, therefore, been with no little interest that I have watched the results of a series of experiments which I have recently been conducting with a certain aphid commonly infesting orpine (live-forever). This aphid causes a ruffling of the orpine leaves which renders its presence conspicuous. It has several color varieties—yellow, pale green, olive green, blackish green—the same range of color varieties, indeed, for which the melon aphid is famous. In structural characters, also, the orpine aphid and the melon aphid are twins.

This season I caged spring migrants (winged females) from orpine on squash, where they settled and produced young which have grown to maturity on the squash. I placed infested orpine plants near growing melons in the greenhouse; and some of the aphids voluntarily left the orpine and went over to the melons and there established thriving colonies of typical *A. gossypii.*

It does not, therefore, seem premature to report that the primary food plant of *Aphis gossypii* is *Sedum Telephium,* from which it migrates to its various summer food plants.

EDITH M. PATCH

MAINE AGRICULTURAL EXPERIMENT STATION

ILLITERACY IN THE COLLEGES

I HAVE felt rather out of patience with articles recently published, enumerating gross errors made by students. Our young people now coming into the universities and colleges have not always had the best advantages, and it is reasonable to expect a certain percentage to be ignorant of many things. If I, a mature teacher of long experience, were given an examination in the elements of engineering, the result would be pathetic or ridiculous to any engineer, according to his point of view. Nevertheless it becomes a serious matter if men go through college, and are sent out to teach others, while incompetent to do tolerably good work or write English correctly. In the field of entomology, we have recently seen the grossest errors in the construction of scientific names in taxonomic papers, emanating from workers in leading institutions. The principles of so-called neolatin allow extraordinary latitude, but the errors referred to result from mere ignorance. The other day a man graduating from a reputable college applied for a teaching position in the University of Colorado. He was supported by a letter from his major professor and a photograph showing him in the costume of an athlete. We had decided not to accept him, but before we could write we received a letter, addressed to "Proff. ——," stating that "Dr. —— of [a large state university] has just made me a very fine assistantship

proposition, which I have excepted. Please consider my application with you void. I thank you as sincerely for the intrest you have shown in me, I consider it an unusual privilage to have been allowed to apply for the assistantship you have." Accordingly, in a few months this man will presumably be teaching in the University of ——.

T. D. A. COCKERELL

MAY 27

THE PURPURIN METHOD OF LOCALIZING CALCIUM

DR. MYRA M. SAMPSON[1] is in error in attributing to me the introduction of the purpurin method of localizing calcium in animal and vegetable cells.

This method was first advanced by Grandis and Mainani in 1900 (*Arch. Ital. de Biol. 34,* 73) and a paper of theirs in the same Archives (1902, *38,* 143) gives the results of their use of the method in studying the distribution and deposition of calcium in epiphysial cartilage during bone formation.

In 1903, and later, I put this method to the test and found that while it is serviceable in localizing calcium in certain structures, *e.g.,* epiphysial cartilage, in which its salts may abound, it does not give decisive results in tissues or cellular elements in which it undoubtedly occurs, but much less abundantly, because the reagent is not sensitive to calcium when the latter is in greater dilution than 1 in 800, and it reacts the more slowly the more this degree of dilution is approached.

It is possible, however, that a mode of using the reagent, which will increase its sensitivity to calcium, may be found. A sensitive microchemical reagent for calcium in tissues and cells is a great desideratum and I would express the hope that Dr. Sampson will endeavor to find such a method and succeed in doing so.

A. B. MACALLUM

MCGILL UNIVERSITY,
MONTREAL, CANADA

SCIENTIFIC BOOKS

The Chemistry of Wheat Flour. By DR. C. H. BAILEY, New York: The Chemical Catalog Company, Inc., 1925.

BREAD is our fundamental diet. The more we can learn about it the better will our judgment be respecting its use. A study of the milling processes now in vogue is extremely important for the chemist and more so for the biologist. This work is a rich treasure of knowledge in regard to the milling processes by means of which wheat is converted into flour. The author had a particularly good opportunity of collecting the information in this book because of his location in the midst of the greatest milling region in the world and because of his own studies in the milling industry.

In his introduction he calls attention to the general plan of the work. The properties of flour are to be considered in their relation, first, to the raw state from which they are manufactured, namely, wheat; second, to the process of milling and third, to its adaptability to the principal use to which flour is put for baking.

A short sketch of the history of baking is found in Chapter I. This is particularly interesting now because we learn from it when the present system of milling was introduced into this country. In 1870 the purifier was introduced into the mills in Minneapolis. In combination with the new system of grinding, that is, using steel breakers instead of millstones with the purifying apparatus, it made the mills of Minneapolis famous. Following the new system of milling, according to the author, the next major development was the introduction of chemical bleaching of the finished flour, a practice which came into effect in the first decade of the present century.

The author departs very materially from his fundamental principles in introducing the discussion of the bleaching of finished flour. This practice has nothing whatever to do with milling but has to do with the products of milling and the health of the consumer. It is not, therefore, a part of the fundamental principles on which the book is said to be written.

This view is also held by Samuel T. Ballard, a prominent miller of Louisville, a witness for the United States at the famous bleached flour trial, as shown from the following extract from his testimony:

> I consider that bleaching is no part of the milling process. Milling consists in making pure flour and separating all impurities from it. After the flour is made I do not consider treating it with chemicals any part of the milling art. Natural aging improves the quality of flour. Bleached flour deteriorates from the day it is made.

The general accomplishments, up to the present time, are stated by the author in the following language:

> In both of these particulars remarkable success has attended his efforts until to-day the modern flour mill is one of the most completely automatic establishments of

[1] SCIENCE, October 30, 1925, p. 400.

the food industries, and the whiteness of the flour which can be produced from the pigmented wheats with dark colored, vitreous kernels is remarkable.

I shall return to this point further on.

In Chapter II a fine discussion of wheat in its relation to flour composition is found. The various kinds of wheat for the production of various kinds of flour are set out and the experimental work for determining which of these kinds of flour are best adapted to particular purposes is given in sufficient detail to throw a flood of light upon this whole question.

In connection with these studies the supreme importance of a proper protein content for the baking of bread is duly stressed. The experiments which have been conducted for producing flour of great strength, that is, capable of holding moisture, by the amount and character of its gluten are given in great detail.

Chapter III is given to the development of the wheat plant and kernel along these lines.

In Chapter IV the influence of environment on the composition of wheat is discussed. It is well known that wheats of rapid growth, that are sown in the spring, develop a much greater content of gluten than wheat sown in the fall. This has shown the way to a distinct class of wheat products with a high content of gluten which is one of the most important constituents from the point of view of panification. Cool summers with high rainfall and a relatively long growth period result in the production of wheat with a high percentage of starch and a low percentage of protein. Climatic conditions are responsible for all the great variations in the composition of wheat, and of these quick growth and dry weather at the time of ripening are the greatest factors in the production of high protein harvest products.

Chapter V is given to the character of impurities and the methods of cleaning commercial wheat.

Chapter VI discusses the storage and handling of wheat. These are most important factors to the farmer himself as it will lead him to follow those methods of storage and handling of wheat which give the greatest rewards for his labor.

Chapter VII deals with the composition of the various products of roller milling. It is by far, in my opinion, the most interesting chapter in the book. The author recognizes the early activities of the Bureau of Chemistry in the study of the chemistry of roller milling. He does not, however, stress the fact that the first complete study of the chemistry of the roller milling process ever made in this country was conducted in the Bureau of Chemistry by Clifford Richardson, my first assistant therein. The results obtained by Richardson are still classic and have been confirmed by all subsequent investigators along that line. It has long been a subject of discussion why it is that in the modern milling of flour a large increase of moisture is effected without apparently exciting the attention of any of the executors of the pure food laws, either of nation or of state. It seems rather strange that if you add two or three per cent. of water to oats or to corn to be fed to cattle or horses, the food laws find this to be an adulteration and many convictions for this practice have been secured. On the other hand, in the "conditioning" of wheat, as it is called, for grinding in a modern mill it is always submitted first to the operation of moisture and from two to four per cent. of water, according to circumstances, is incorporated. It is true some of this added moisture may escape during the processes of milling because of the exposure of the wheat to the air, but the flour produced by the modern methods of milling always contains a considerable increase of moisture over the wheat from which it has been formed. This is really an adulteration, although the amount of increased weight is not very great. If there be two per cent. additional moisture in a barrel of flour weighing approximately two hundred pounds, there are four pounds of added water sold to the purchaser. This is a very considerable increase in the weight of flour without any additional nutrient compensation. The only limit of the amount of added water seems to be the suitability for grinding. The purpose of the added water is to make the bran more tough so that, as it is run through successive rollers and flattened out, it keeps its form while it permits all attached starch particles to be removed. Thus, there is a very complete separation of the bran and, to a certain extent, the moisture also facilitates the separation of the germ, both of which components of wheat it is the object of the modern miller to remove as perfectly as possible.

The methods of conditioning, the amounts of moisture added and the results of thus preparing the wheat and kernel for the purpose of making the maximum amount of white flour are duly set forth and explained in a very illuminating way by the author. In spite of the conditioning, however, some particles of bran are comminuted and the number of bran particles in the flour in its successive steps from grain to pure flour increases.

In table 83 on page 146 the number of particles of bran in the first break was 113, while the number at the fifth break was 368. This does not mean that there was any more bran in the flour. There was probably a great deal less, but it means that the particles that are in the flour have been more finely

comminuted. In the first middlings the number of bran particles was found to be 21, while in the eighth middlings they had reached 264. The object of the modern-day miller is to get all bran particles out of the flour as particularly as possible, and also all particles of the germ. To this end the refinement of milling has been chiefly directed for the last few years. The result is that the flour of the country is gradually approaching the condition in which the bran and germ remnants are reduced to the greatest possible minimum. This means a more thorough extraction from white flour of the vital elements of the wheat. While the flour is improved in color it is distinctly deteriorated in nutritional value.

Chapter IX is the only questionable chapter in the book. It treats of the color of flour and flour bleaching. The various methods of bleaching flour are described in detail, and also the number and character of the bleaching reagents. There may be some difference of opinion in regard to the origin and practice of the bleaching process. The millers claim that the bleaching process has arisen by reason of the demand of the consumer for a whiter flour. This may have some merit if by the consumer is meant the retail dealer. I doubt, however, if any household consumer ever demanded from the millers a whiter flour. The housewife, as a rule, never sees the flour that she buys. It is always in a sack or package of some kind and very rarely is it sold in bulk. If it is, she does not gage its value by its color. She never sees it until it reaches her home. There is no doubt of the fact that the brokers and buyers of flour are willing to pay a higher price for a whiter flour. The patent flour, so-called, as first mentioned, filled this bill, but it was not possible to get all the flour into the patent classification. There was always a remainder amounting to some five to fifteen per cent. which refused to become sufficiently white to be sold as patent flour. By the bleaching of the whiter portions of this residue it could be mixed in with the patent flour and sold at the patent price. This fact was clearly brought out in the courts of justice and in the arguments made before the Bureau of Chemistry for the justification of the bleaching process.

I have no time here to discuss the mechanical methods by means of which the bleaching takes place. I can only enumerate the principal bleaching reagents. One of the most common and effective of these reagents is nitrogen peroxide or a mixture of nitrogen and nitrous oxides. This is generated by a chemical reaction or by a flaming arc passing through the atmosphere and causing a combination of nitrogen and oxygen of the atmosphere.

Other reagents are ozone, sulphur dioxide, chlorine and certain compounds of chlorine, such as nitrosyl chloride, nitrogen trichloride and certain organic peroxides, notably benzoyl peroxide, nitrous oxide as sodium nitrite, a somewhat evanescent compound, liquid chlorine, nitrogen trichloride, benzoyl peroxide, peraldehydes, ozonides, perozonides and peroxozonides.

Among these reagents which have been extensively used there are many that are dangerous by reason of their tendency to explode. Benzoyl peroxide belongs to this class and this is a reagent which has been extensively used in the commercial bleaching of flour. In the market it is known under the trade name of Novadelox B, which is a mixture of benzoyl peroxide (25 parts), and calcium phosphate (75 parts.) The author says that the last-named substance is used in the mixture to reduce its inflammability and its liability of spontaneous combustion. There are other reagents along this line. The author gives a very fair summary of the opinions of experts, particularly those engaged in the bleached flour trial in regard to the effects of bleaching upon the character of the dough and the bread made therefrom. After citing the testimony on both sides he sums up the matter in the following paragraph:

> The weakness of the contention that bleaching constitutes a hazard in the nutrition of man because bleached flour is less digestible than unbleached, lies in part in the fact that flour is not eaten in the raw state, and experiments with raw flour are hardly valid as evidence. In such experiments as have been reported in which a baked product or bread was used, the resulting data justify the conclusion that the effect of bleaching on digestibility is too slight to merit consideration.

I consider the above conclusion unfortunate. The evidence of injury to the digestibility came from sources beyond criticism and should not be dismissed in such a summary way by the author. This paragraph has had this effect upon me and probably will have the same effect upon other unprejudiced readers, namely, that the author, in view of the almost universal practice of bleaching, is inclined to condone it and consider it as a legitimate part of milling. The fact that bleaching can only be accomplished by the intake of powerful reagents and that these reagents must of necessity remain, to a certain extent, in the baked product does not justify his conclusion, but rather indicates a considerable bias towards the side of the bleachers. If any evidence could be adduced in regard to any beneficial effects from the process of bleaching, it has not been cited by the author.

In the eyes of the law, a food product is judged on its own constitution and not what may be done

with it subsequently. This is also the opinion of the Supreme Court of the United States in its decision on the bleached flour case. The court makes the following illuminating statements:

It is not required that the article of food containing added poisonous or other added deleterious ingredients must affect the public health, and it is not incumbent upon the Government, in order to make out a case, to establish that fact. The act has placed upon the Government the burden of establishing, in order to secure a verdict of condemnation under this statute, that the added poisonous or deleterious substances must be such as may render such article injurious to health. The word "may" is here used in its ordinary and usual signification, there being nothing to show the intention of Congress to affix to it any other meaning. "It is," says Webster, "an auxiliary verb, qualifying the meaning of another verb by expressing ability, . . . contingency or liability, or possibility or probability." In thus describing the offense Congress doubtless took into consideration that flour may be used in many ways—in bread, cake, gravy, broth, etc. It may be consumed, when prepared as a food, by the strong and the weak, the old and the young, the well and the sick; and it is intended that if any flour, because of any added poisonous or other deleterious ingredients, may possibly injure the health of any of these, it shall come within the ban of the statute.

Also, the jury after hearing all the evidence in the case of injury to the flour by the Alsop bleaching process brought in a verdict for the government on all the counts in the libel. These counts included injury to the flour for making bread and for being colored in such a way as to conceal inferiority and thus permit the sale of the flour at a higher price.

The only point in the verdict of the Supreme Court reversing the conclusion of the lower court was on the failure of the judge in the lower court to instruct the jury properly in regard to injury to health. The Supreme Court did not enter into any discussion of the merits of the case whatever. It would be proper to state that when the case was remanded to the original court for a new trial, the United States attorney agreed to withdraw that part of the libel charging injury to health, whereupon the claimants acceded to all the other parts of the libel and the decree of the court condemned the 625 sacks of bleached flour, in the following terms:

Now, therefore, it is ordered that the said amended libel be taken pro confesso; and the said cause coming on to be heard ex parte, and the court being fully advised, doth find all of the allegations of said amended libel herein are true.

It is, therefore, ordered, adjudged and decreed that the said six hundred and twenty-five (625) sacks of flour, more or less, as aforesaid, be and the same are hereby condemned and forfeited to the United States, and the marshal of this court is hereby ordered and directed to proceed to confiscate and utterly destroy all of said property, and to report to this court how he executed this order and decree.

It is further ordered, adjudged and decreed that the taxed costs of the libelant herein, and the taxed costs of the claimant, be paid by the claimant, Lexington Mill and Elevator Company, said claimant in open court consenting thereto.

The above condemnation, it seems to me, is more nearly in harmony with the facts of the case than the author's conclusion as to the practical harmlessness of bleaching above referred to. In spite of the fact that this decision, from which, of course, no appeal could be taken, as it was a consent decree, settled once and for all the legal status of bleached flour and opened a clear way for the complete suppression of bleaching except when the flour was consumed within the state in which it was bleached. As most bleached flours transgress state lines, if this decree had been properly enforced the bleaching of flour would have entirely ceased within a short time.

Unfortunately, the authorities having in hand the administration of the law failed to improve this opportunity of forever destroying this reprehensible process. On the contrary, they issued a statement which was considered an invitation by the flour bleachers to go to the limit in extending this practice. The fact that there were many important problems which had been settled by the court seemed to have escaped their notice and they published a statement as follows:

No action will be taken at the present time on the ground that the bleaching introduces into the flour a substance which may be injurious to health provided, as a result of bleaching there is not introduced such a quantity of the bleaching agent as to render the flour injurious as indicated in the decision of the Supreme Court.

This was understood by the flour bleachers to mean that no action of any kind would be taken against bleached flour on the other grounds which had been established by the court as the reason for condemning bleached flour as both adulterated and misbranded. In point of fact, no action of any kind ever has been taken by the properly constituted authorities to hold in check or to stop the bleaching of flour, and it has become well-nigh universal. Even the millers who were bitterly opposed to bleaching have been forced to practice it in order that they could sell in the markets of the country a larger percentage of their output as patent flour. The most remarkable statement, however, of the food enforcing authorities is the following:

Whether bleaching in any given shipment reduces the quality and strength of the flour or conceals damage or inferiority must be decided on the basis of facts in each particular case.

These were the very facts that were decided by the court. This particular phrase, of course, was understood by the bleachers as a general statement which indicated that the whole evidence in regard to concealing damage or inferiority or in reducing the quality and strength of the flour would have to be gone over again, as the authorities simply ignored that these matters were already settled once and all in the decree of the court.

The curse of the corpse-white flour will, of course, die out in time. The people of our country are learning little by little that the whiteness in the flour is inversely proportional to its nutritive value. It has been established by the experiments of the Public Health Service that white flour fed to fowls induced a speedy occurrence of polyneuritis or beriberi which quickly proved fatal. On the other hand, the fowls of same quality and age fed upon the whole grain wheat, or wheat flour made of whole grain, at the end of ninety days, when all the white flour fed fowls were dead, showed no sign of even an approach of beriberi or polyneuritis.

Facts of this kind which have now been established by all investigators will gradually permeate into the conscience of our people and lead to such a demand for wholesome flour that the process of bleaching, if never again attacked by the authorities of the government, will lapse of its own innate prejudicial character. Our bread supply will then be restored to normal, and thus the cheapest source of food for our people be preserved in its natural degree of wholesomeness. It is, of course, a matter of regret that a work of such high character and value as the one in question should so far lose sight of the fundamental principles of nutrition as to convey an impression to the reader that the bleaching of flour is a wholly innocuous and apparently praiseworthy proceeding.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A RAPID METHOD FOR DEMONSTRATING THE EFFECTS OF PLANTS ON A CULTURE SOLUTION

TEACHERS or students of plant physiology may find the method here described useful in demonstrating very easily and graphically within a few hours the changes in concentration of various ions in a solution produced by the growth of plants in the solution. The chief difference between this and the usual methods of growing plants in culture solution consists in the much larger ratio of plants to volume of solution used in this method. With this procedure, it is easily possible to demonstrate to a class of students that plants absorb different ions at very different rates and thereby cause very considerable changes in composition of the culture solution.

The technique is as follows, actual figures from a certain experiment being given. A number of trials with similar procedure at different times have given similar results.

To five grams (about two hundred seeds) of club wheat kernels in a test tube were added 5 cc of water. After two hours the grain was spread on wet filter paper and covered with two sheets of the same paper. The whole was thoroughly wet, placed in a pan and covered with another pan to keep the seed moist. After two days, the roots were about 1 cm long. The sprouted grain was then spread on a piece of mosquito net tied over the mouth of a glass jar 8 cm in diameter and covered with wet filter paper. The jar was kept filled with tap water up to the net. Two days later, the roots had gone down into the water and the young shoots were about 1 cm high. The wet filter paper cover was then removed, leaving the plants exposed to the air. Six days later, the young shoots were 7 to 12 cm high, with roots about the same length. Five days later, the plants were 10 to 15 cm high, growing vigorously. During all the time the plants were kept in a south window at a temperature of 60 to 75° F.

At this time, when the plants were fifteen days old from the time seed was soaked, the net was removed from the top of the jar, the roots of the plants washed in distilled water, and the whole mass of plants was then placed upright in a beaker 6 cm in diameter. Thus the roots were compressed into a small space. Now absorption experiments were begun. On successive days the plants were supplied with dilute solutions of single salts, the volume of solution being just sufficient to keep the roots immersed. If necessary, more water was added in order to maintain sufficient liquid to cover the roots. At the end of the period of absorption, the remaining solution was made up to the original volume with distilled water and tests made for ions remaining. Portions of the original solutions were tested in the same way at the same time. The tests were only very roughly quantitative. The results obtained are set down in the following table. The numbers given represent milligrams of the ions present before and after the absorption period. In some cases, a considerable

CHANGES IN CULTURES SOLUTION CAUSED BY GROWTH OF WHEAT PLANTS

Date 1925	Time	Salt Used	Vol. of soln. c.c.	pH after	Ca		Mg		K		SO_4		PO_4		NO_3		
					Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
5/25	8–5	KNO_3	50	5.6	0	0.5	—	—	12	0	0	0.07	—	—	18	+	
5/26	8–5	KCl	50	5.3	0	0.1	—	—	12	0	0	0.00	—	—	—	–	Much Cl
5/27	24 hrs.	$Ca(NO_3)_2$	50	7.3	7	1.7	—	—	0	0	—	—	—	—	14	0	
5/28	"	KH_2PO_4	50	4.0	0	0.7	—	—	16	0	—	—	38	+++	—	–	
5/29	"	$KHCO_3$	100	5.5	0	0.0	—	—	20	0	—	—	—	—	—	–	
6/1	3 days	KNO_3	100	6.6	0	Tr.	—	—	39	0	—	—	—	—	62	0	
6/2	24 hrs.	$NaNO_3$	50	7.4	—	—	—	—	—	–	—	—	—	—	18	0	
6/3	"	KNO_3	100	6.7	0	0	—	—	20	0	—	—	—	—	31	0	
6/4	"	$Mg(NO_3)_2$	100	7.2	—	—	6	+++	—	–	—	—	—	—	31	0	
6/5	"	KCl	100	7.0	0	0	—	—	39	+++	—	—	—	—	—	–	Much Cl
6/6	"	$(NH_4)_2SO_4$	100	3.0	—	—	—	—	—	–	48	+++	—	—	—	–	Before NH_4 18 / After +++
6/8	2 days	$Ca(NO_3)_2$	100	6.8	14	++	—	—	—	–	—	—	—	—	29	0	
6/9	1 day	$MgSO_4$	100	5.8	0	0	8	++	—	–	32	+++	—	—	—	–	
6/10	"	KH_2PO_4	100	3.5	—	—	—	—	16	+	—	—	38	+++	—	–	

amount of the ion was indicated by the signs +++, less by ++, and still less by +.

The various ions were detected by means of the following reagents:

For Ca	Ammonium oxalate
" Mg	$Na_2HPO_4 + NH_4OH$
" K	Sodium cobalti nitrite reagent
" SO_4	$BaCl_2$
" PO_4	Acid ammonium molybdate
" NO_3	Diphenylamine, .01% in H_2SO_4
" pH	Phenolsulfonephthalein indicators

By examination of the table, it may be seen that when KNO_3 was used in small amounts, both anion and cation were completely removed from the solutions by the plants in nine hours, the solution remaining nearly neutral. When KCl, KH_2PO_4 or $KHCO_3$ were used, the K was absorbed, but not all the anions. When $Ca(NO_3)_2$ or $NaNO_3$ were supplied, the NO_3 was used up, but most of the cation was left in the solution which became alkaline. When $(NH_4)_2SO_4$ was given, much of both ions remained unabsorbed, but more NH_4^+ than SO_4^{--} had been absorbed, so the solution became acid. Also, when KH_2PO_4 was given, the absorption of K^+ being relatively greater than of $H_2PO_4^-$, the solution became more acid.

For demonstrating these effects to a class, the following procedure is suggested:

Three weeks or more in advance of the day of demonstration, prepare as many jars of plants as are needed for the several tests to be made. Some hours before the class meeting the plants are placed in the various solutions, portions of which are kept unused. At the time of demonstration, the same test is applied to the solutions before and after the plants have been grown in them. If properly managed, the difference between the two solutions before and after the action of the plants may be made easily visible to a good-sized class. The two test tubes, showing the test on the two portions of solution before and after the plants have grown in it, should be exhibited side by side.

For investigational purposes, the same bunch of plants may be used day after day if the roots are well washed in distilled water each time before being placed in a different solution.

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SPECIAL ARTICLES

NOTE ON MAGNETIC DECLINATION

DURING the total eclipse of January 24, 1925, magnetic observations were made at an isolated point near Ithaca, New York. The primary object of the investigation was to record any quick changes in declination of the earth's magnetic field during the time of the eclipse. While the device used could also record the slow gradual changes, it had no advantages in that respect over the vibrating magnet method ordinarily used.

A small bell type magnet, of short period of vibration, was suspended by a quartz fiber in a metal casing and carefully shielded from air currents. By means of a telescope about two meters away, the apparent motion of a cross hair in the telescope was observed as reflected from a small mirror fastened to

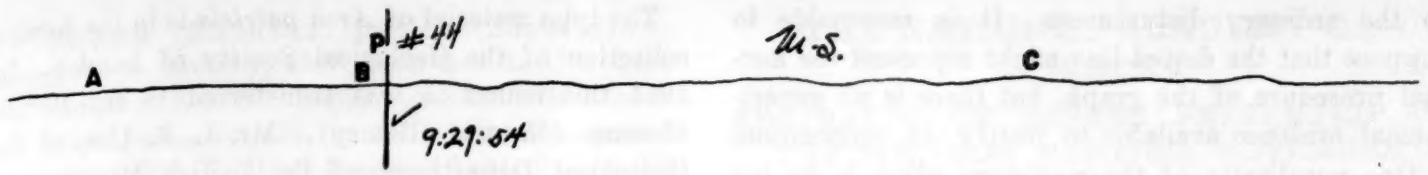

FIG. 1

the stem of the magnet. Attached to a sliding arm was a pointer which could be kept on the moving cross-hair image by the telescope observer. A pen on the other end of the arm recorded the fluctuations directly on a chronograph tape moving about 22 cm a minute, thus giving a continuous record of the declination. Figure 1 is an actual photograph of a portion of the tape, showing the magnetic variations of the earth's field at about 9:30. From A to B on the graph there is no irregularity, thus showing an absence of magnetic disturbance. However at B, the graph becoming very irregular gives evidence of some degree of magnetic storm or other disturbance of unknown origin. The small punch holes made by the recorder every half second served the double purpose of giving the exact time and forming a datum line from which to make measurements of the graph. A second recorder punched the tape at minute intervals as shown at P. The whole apparatus as used had been designed some time previously to record and study local magnetic disturbances, and its accuracy of recording may be greatly varied according to the needs. In case of any local disturbances known at the time, it was found very convenient to telegraph by Morse code any remarks to that effect directly upon the tape at the time of occurrence by means of the second recorder.

The record on January 24 started at about 8:30 continuing until 9:50. There was, throughout, a continual changing observed in the declination complicated by frequent evidences of magnetic storm. The declination increased very rapidly beginning at about 8:55, and reached a definite, fairly sharp maximum at 9:16, which lasted for about two minutes. After this point, it started to decrease at about the same rate as that of increase. However, instead of decreasing continuously, there was a reversal at 9:26 and then after a period of about eight minutes assumed a much slower but steady rate of change.

Figure 2 shows a contracted graph, obtained from measurements on the tape at the one-minute intervals. At the times marked by X the tape record showed various large irregularities, although there were in addition more frequent, smaller deviations. It will be noted that these positions correspond in general to the larger deviations from a smooth curve. The period T–T is that of totality and is marked by some irregularity, although this is probably due solely

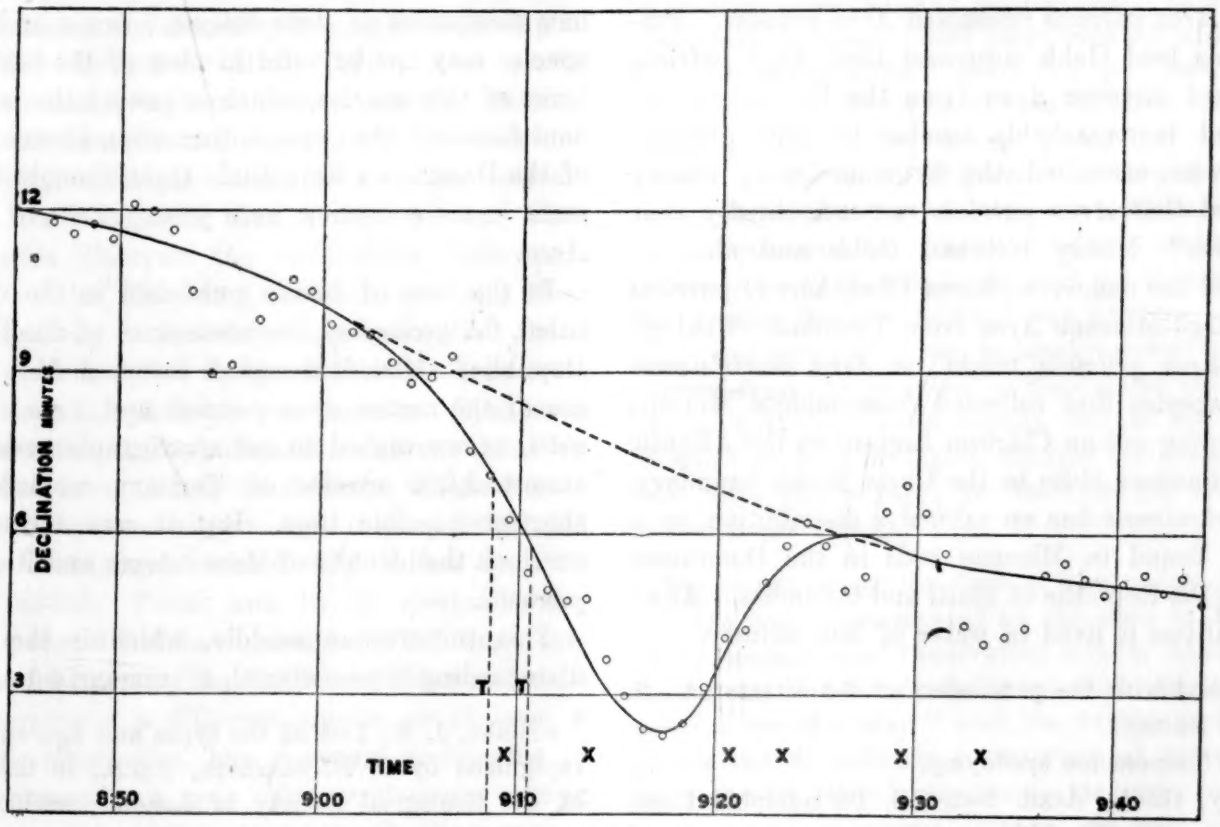

FIG. 2

to the ordinary disturbances. It is reasonable to suppose that the dotted line might represent the normal procedure of the graph, but there is no experimental evidence available to justify the supposition.

One peculiarity of the maximum effect is its lag of about seven minutes behind the period of totality. A second peculiarity is the unexplained reversal which occurred shortly after the maximum. The total angular variation over the period of measurement was of the order of ten minutes. A curve was also obtained the following day, over the same time limits, and showed a very quiet state of the magnetic field.

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ARCA PATRICIA SOWERBY, A MIOCENE FOSSIL FROM THE DOMINICAN REPUBLIC[1]

IN 1850 G. B. Sowerby[2] described *Arca patricia* and other Miocene fossils collected in the valley of Rio Yaque del Norte, Dominican Republic, by Colonel Heneken, a British army officer. This species, like many others described in the same report, was not figured. Almost every writer who has had anything to do with the Miocene mollusks of the Dominican Republic has made a guess as to *Arca patricia,* but none took the trouble to inquire about the type material. Sowerby compared this species with *Arca grandis* Broderip and Sowerby, a giant *Arca* living on the Pacific coast of Central America and northern South America. Therefore, it was natural to suppose that *Arca patricia* resembled *Arca grandis.* Following this lead Gabb supposed that *Arca patricia* is the giant Miocene *Arca* from the Dominican Republic that is remarkably similar to *Arca grandis.* Guppy, who examined the type material, merely commented that *Arca patricia* is "undoubtedly near *A. grandis.*" Maury followed Gabb and also recently used the name *Scapharca (Scapharca) patricia* for the large Miocene *Arca* from Trinidad. Pilsbry[3] thought *Arca patricia* might be *Arca chiriquiensis* Gabb, a species first collected from middle Miocene beds cropping out on Chiriqui Lagoon on the Atlantic coast of Panama close to the Costa Rican boundary. *Arca chiriquiensis* has an extensive distribution, as it has been found in Miocene beds in the Dominican Republic, the Republic of Haiti and Colombia. At all these localities it lived in water of low salinity.

The type material of *Arca patricia* is in the foreign collection of the Geological Society of London. In 1911 this collection was transferred to the British Museum (Natural History). Mr. L. R. Cox, of the Geological Department of the British Museum, recently very kindly sent me a cast of the holotype that is so skilfully made that it looks like an actual shell. Mr. Cox informed me that the type material consists of about twelve specimens, but one specimen (Geol. Soc. London No. 12828) was selected by Blake and Sherborn as the holotype when they compiled the catalogue of type specimens in the collection of the Geological Society of London.[4] The cast shows that *Arca patricia* is very different from both *Arca grandis* and *Arca chiriquiensis;* and, as Mr. Cox suspected, it is the species to which Dall in 1898 gave the name *Scapharca (Argina) tolepia.* Dall's description of this species as an *Argina* misled Dr. Maury, so she gave another name to the same species—*Scapharca arthurpennelli.* The holotype of *Scapharca (Argina) tolepia* Dall (both valves in attached position, U. S. Nat. Mus. No. 113,801) was collected on Rio Amina, a northward-flowing tributary of Rio Yaque del Norte. The type locality of *Scapharca arthurpennelli* Maury is on Rio Mao, a northward-flowing tributary of Rio Yaque del Norte lying west of Rio Amina. The holotype of *Arca patricia* is a little larger than the holotype of *Scapharca (Argina) tolepia;* its posterior end is a little more extended, and its umbo is not so broad. Both specimens can, however, be duplicated in a series of about 150 topotypes of *Scapharca arthurpennelli.* Pilsbry and Johnson described three new subspecies of *Arca tolepia.* Some of these subspecies may not be valid in view of the variable features of this species, which is one of the most abundant fossils in the Cercado formation (lower Miocene) of the Dominican Republic. Gabb thought the specimens in his collection were young shells of the giant *Arca.*

In the lists of fossils published in the report entitled, "A geological reconnaissance of the Dominican Republic," Mansfield and I followed Maury in the use of the names *Arca patricia* and *Arca arthurpennelli,* as we wished to get stratigraphic results from almost 1,000 species of Tertiary mollusks in the shortest possible time. But it was inexcusable to overlook the identity of *Arca tolepia* and *Arca arthurpennelli.*

This picturesque muddle, which is the result of disregarding type material, is summarized as follows:

[1] Published with the permission of the director, U. S. Geological Survey.

[2] For references see synonymy.

[3] Pilsbry, H. A., Acad. Nat. Sci. Philadelphia Proc., Vol. 73, pp. 405–406, 1922.

[4] Blake, J. F., List of the types and figured specimens recognized by C. D. Sherborn, F.G.S., in the collection of the Geological Society of London; verified and arranged with additions, p. 65, 1902.

Barbatia (Scapharca) patricia (Sowerby).

Arca patricia Sowerby, 1850, Geol. Soc. London Quart. Jour., Vol. 6, p. 52. Guppy, 1876, Geol. Soc. London Quart Jour., Vol. 32, p. 531. Not *Arca patricia* Guppy, 1903, Trinidad Botanical Dept. Bull., p. 541. (Reprint, Bull. Am. Paleontology, Vol. 8, pp. 279–280.) Not *Scapharca patricia* Maury, 1917, Bull. Am. Paleontology, Vol. 5, p. 337, pl. 53, fig. 1. Not *Arca* (*Scapharca*) *patricia* Woodring and Mansfield, 1921, in Vaughan and others, Dominican Republic Geol. Survey Mem., Vol. 1, pp. 102, 154, 164. Not *Scapharca* (*Scapharca*) *patricia* Maury, 1925, Bull. Am. Paleontology, Vol. 10, pp. 209–210, pl. 13, fig. 5.

Arca (*Anadara*) *grandis* Gabb, 1873 (part, not Broderip and Sowerby), Am. Philos. Soc. Trans., new ser., Vol. 15, p. 253.

Scapharca (*Argina*) *tolepia* Dall, 1898, Wagner Free Inst. Sci. Philadelphia Trans., Vol. 3, pt. 4, pp. 649–650, pl. 33, figs. 7, 8. (The citation of Bowden, Jamaica as the locality of the figured specimen is an error.)

Scapharca arthurpennelli Maury, 1917, Bull. Am. Paleontology, Vol. 5, p. 342, pl. 55, figs. 9, 10.

Arca (*Scapharca*) *arthurpennelli* (Maury), Woodring and Mansfield, 1921, in Vaughan and others, Dominican Republic Geol. Survey Mem., Vol. 1, pp. 97, 122.

Arca (*Argina*) *tolepia* (Dall), Pilsbry, 1922, Acad. Nat. Sci. Philadelphia Proc., Vol. 73, p. 406.

Arca patricia has the external features of an *Argina*, but has the cardinal area and hinge of the so-called *Scapharcas*. Both *Arca chiriquiensis* Gabb and the Miocene species from the Dominican Republic, Trinidad, Tobago and Colombia resembling *Arca grandis* Broderip and Sowerby belong to the group of *Arcas* called *Senilia* by Gray (type, *Arca senilis* Linné, a species living on the west coast of tropical Africa from Senegal to Angola). No *Senilias* and no so-called *Scapharcas* similar to *Arca patricia* are living in the Caribbean Sea at the present time. These species illustrate the remarkable deployment of *Arcas* in the Miocene Caribbean Sea and their present relatively impoverished representation there.

Pilsbry considers that the giant Miocene *Arca* from the Dominican Republic is *Arca grandis*. Specimens from the Dominican Republic and also from Colombia and Trinidad have crudely beaded ribs, whereas *Arca grandis* has clean-cut ribs, except in very large and heavy specimens, and usually only a few anterior ribs are beaded. Fossil and living specimens are variable in shape and have essentially the same cardinal area and hinge. The Caribbean Miocene fossils seem to represent a different species or at least a recognizable subspecies, but it seems inadvisable to propose a name in a note that could easily escape attention.

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ABSTRACTS OF PAPERS PRESENTED AT THE MADISON MEETING, NOVEMBER 9, 10 AND 11

Proper motions of stars obtained with the blink microscope: FRANK E. ROSS (Introduced by Edwin B. Frost). In the past, proper motions have been obtained by comparing positions of the stars measured with the meridian circle at distant epochs. In this way the motions of all the brighter stars have been obtained. The accuracy, however, is not great, on account of the uncertainty of the zero point at different epochs. Direct measures of photographs secured at epochs well separated in time, in general greater than ten years, yield better values. The blink comparator has been devised for the rapid comparison of photographs of the same field of stars secured at different epochs. With this instrument stars of large proper motion are instantly detected. There is urgent need of surveying the entire sky in this manner, for the detection of all the stars of large proper motion, in order that a true picture of the space which is contiguous to our sun may be built up. Professor E. E. Barnard secured the photographs of the necessary quality covering approximately one half of the sky. These fields are now being duplicated and compared by the writer. The minimal magnitude is approximately 15, and the lower limit of proper motion about 0.1 per year.

Radial velocities of 368 helium stars: EDWIN B. FROST, STORRS B. BARRETT and OTTO STRUVE. This paper gives the results of the measurement of 2,431 spectrograms of 368 helium stars (Harvard class B). The work has been in progress since 1901 and includes nearly all stars of the class, brighter than visual magnitude 5.5 and north of 15° south declination. Forty-two per cent. of these stars, or one out of 2.4, have been found to spectroscopic binaries, necessitating many plates for finding the velocity of the center of gravity of the pairs.

A solution for the whole group yields a velocity of 17.2 km per second for the solar motion, directed toward $\alpha = 284°$, $\delta = +12°$, with a value of the K-term of +5.6. The average residual velocity was 10.0 km per second. A distinct increase in the residual velocity is shown in passing from the brightest to the fainter stars. Inclusion of data from other sources, for the southern stars of which we have no plates, changes the position of the solar apex very slightly, but increases the solar motion to 26 km per second.

The constancy of the light of stars: JOEL STEBBINS. "It has been demonstrated by the work of the Smithsonian Astrophysical Observatory and its stations, under the direction of Dr. C. G. Abbot, that the sun may be called a variable star," said Dr. Stebbins. "That is, the amount of radiation in the form of light and heat which the sun emits is not always the same, but changes to the extent of several per cent. on each side of the average. The results of the Smithsonian observers are being used to study the connection between weather

changes and variations in the sun, with considerable promise of success." Since the sun is only one of many million stars, the question arises how near is this variability of the sun typical of the stars in general. Roughly, the stars may be divided into those which are white hot, yellow hot and red hot, the sun being a yellow star. The chief work of the Washburn Observatory lies at present in the measurement of minute fluctuations in the light of stars by means of an electric-cell photometer. With this instrument it is possible to measure the constancy of the light of one star by referring it to two or more other stars for comparison. In this way the eclipses of stars by dark companions may be studied and also other variations in light. Several cases have been found where white-hot stars have changed as much as one per cent. between one year and the next, and other cases where the change is more rapid—two or three per cent. in as many weeks. Some yellow stars like the sun seem to have irregular variations of two or three or even five per cent., while certain red stars may change as much as twenty, thirty or forty per cent. "These minute changes like that of one per cent. per year may not seem very great," Dr. Stebbins commented, "but when it is considered that the stars are supposed to shine with much the same brilliance for thousands or millions of years, it is evident that any progressive change of one per cent. annually can not continue for many years in succession. It is suggested that the stars have some way of automatically regulating their radiation so that when they are so much below normal in some way they recover, and likewise when they become brighter than normal the successive radiation is made to decrease."

Recent physiographic observations in the Laramie Range, Wyoming: JAMES FURMAN KEMP. The speaker has been in the field in the Laramie Range during two recent summers, with Professor S. H. Knight, of Laramie, and with him has studied the phenomena. An interesting case of superimposed drainage is furnished by Sybille Creek, a small stream twenty-five to thirty miles north of Laramie City. It rises in the Precambrian center of the range, flows westward to the outside Mesozoic, turns north for three miles, and then abruptly east and northeast across the range in a deep canyon, ultimately joining the North Fork of the Platte. Inside its bend and now the location of a small tributary is a glacial valley, excavated in the granites, of perfect U-shape, and with small hanging valleys and waterfalls. The canyon, known as Long Canyon, is about two hundred feet deep, five hundred to six hundred feet wide and three to four miles long. It cuts squarely across the earlier drainage and is obviously of quite recent age. A few pictures were given of the large canyon of the North Fork of the Platte, below the Pathfinder dam, showing its superimposed character and, in the more open part of its course, its passage squarely across an anticlinal ridge several hundred feet high, formed of the Casper (Pennsylvanian) strata.

When certain mathematical formulas became true: G. A. MILLER. If we substitute for sin x and cos x in the common modern formula $\sin^2 x + \cos^2 x = 1$, the values of these functions for an arbitrary angle as given in the well-known table by J. Napier (1550–1617) the first member of this equation will be the enormous number of one hundred trillion instead of one, as required by this formula. Hence it is clear that at the time of Napier this formula would not have been generally regarded as true even if it is true for the values of sin x and cos x found in certain earlier tables. The trigonometric functions were probably never defined as pure lines, but they were commonly defined as *measured* lines until the time of L. Euler (1707–1783). While in a particular case our modern ratio definition appears already in the ancient Egyptian work by Ahmes this was replaced by measured line definitions, and the ratio definitions did not receive clear and permanent recognition until the time of Euler. The main object of Professor Miller's paper was to exhibit relations between the times when certain modern mathematical formulas actually appeared and when they would have been regarded as true in their modern form. The paper is expected to appear in *Science Progress.*

Hysteresis and atomic magnetostriction: G. W. STEWART and R. L. EDWARDS. The remarkable properties of permalloy has led McKeehan to an atomic theory of magnetostriction which is an interesting contribution. The phenomena herein reported can not be explained by the McKeehan theory but indicate a strong influence of crystalline condition upon hysteresis. The phenomena are: (1) The hysteresis of thin films (made by evaporation) of Ni and Fe, its increase with freedom from gas and with larger crystals; (2) the critical thickness of Fe films. A study of these effects shows the inapplicability of atomic magnetostriction, for there is no strain present in the films, and the effects caused by variation in treatments are large.

A spectroscopic study of the excitation of mercury vapor by positive ion impact: B. M. KNUTSON and JOHN T. TATE. The spectrum of mercury when excited by positive ion impact in mercury vapor differs from that excited by electron impact in the great preponderance in intensity of 2,537 over all other lines. When the positive ions have a velocity less than 100 volts, it requires a long over-exposure of 2,537 to detect the other arc lines. As the velocity is increased these lines become more prominent, but even at 1,800 volts they are relatively fainter than in an electron arc at 15 volts. It may be concluded that the efficiency of ionization by positive ion impact increases steadily up to at least 1,800 volts. A comparison of the spectra due to sodium ions with those due to mercury ions shows that sodium ions at 150 volts give about the same relative intensities of lines as mercury ions at 1,300 volts. This suggests that the extent of the excitation produced in an atom by positive ion impact is largely controlled by the velocity of the ion and not by its energy.

Polarization of resonance radiation in magnetic fields: A. ELLETT. In the absence of an applied magnetic field some resonance lines show polarization, while others do

not. It appears that those lines which would be expected to show polarization in a magnetic field parallel or perpendicular to their electric vectors always show more or less polarization in the absence of a field and that lines which would not be expected to show polarization in a field show no polarization in the absence of a field. Briet has put forward a theory to account for the polarization of resonance radiation in strong magnetic fields, and this theory gives remarkably good agreement for certain resonance lines, with certain orientations of the impressed magnetic field, while in other cases there are outstanding discrepancies. The rotation of the plane of polarization and the decay of polarization with increase of magnetic intensity of the light emitted parallel to the impressed field in weak fields may be accounted for qualitatively by the Larmor precession of the excited atoms, as Eldridge and Breit have shown. However, the usual law of distribution of the lines of excited atoms leads to equations for the per cent. polarization and angle of rotation which are not similar to the experimentally determined relations. If we assume that the law of decay of excited atoms is of the form $\frac{dN}{dT} = -N_0\, e^{-a(H+B)T^2}$ where a and B are arbitrary constants and H the impressed field then we find that the law of decay of polarization is $P = P_0\, e^{-KH}$ where P_0 and K determine a and B. The equation connecting the rotation of the plane of polarization and the field strength becomes $\tan 2\,O = e^{q^2}\,(2q - \frac{(2q)^3}{6}\,\frac{(2q)^5}{60} \cdots$ etc.) where $q = \frac{KH^2}{H+B}$ and this gives very good agreement with the observed values in the case of the 2,536 Hg line. The value of T, the mean life of an excited atom in a field of .60 gauss, is computed from observed values of P_0 and K to be .99 10^{-7} seconds which agrees well with Wien's value of 1.02 10^{-7}.

A study of the thermal properties of air: J. R. ROEBUCK. The thermal properties of air were studied by means of a series of experiments on the Joule-Thomson effect. Air compressed to a chosen pressure (100 to 220 Atm.) was passed through a temperature equalizing coil in an oil bath held at a series of temperatures between 25° and 300° C., and then through a porous partition, across which the pressure dropped a chosen amount and the change in temperature of the air was carefully measured. For this to be experimentally possible, the bath temperature and initial pressure required very careful regulation, and apparatus suitable for these purposes was developed. To obtain the maximum amount of information the measurements were arranged in groups, in which the pressure dropped successively from the same initial pressure to a series of successive values. A plot of the resulting values of pressures and temperatures gives an isenthalpic curve, and a group of such curves were obtained filling in the above regions of temperature and pressure. The slope (μ) of these curves is called the Joule-Thomson coefficient, which was obtained from the data of these curves by taking successive differences, and μ has been plotted as a function of temperature and pressure. These values of μ have been used to obtain the values of the specific heat of air as a function of the pressure when it is already known as a function of the temperature. They were used also to calculate the value on the Centigrade scale, of the thermodynamic zero, giving −273.15° C., depending somewhat, however, on the value used for the coefficient of expansion. This also allowed of calculating the value of the coefficient of expansion as a function of pressure. The work is being extended to temperatures below that of the room.

Polarized summary of paper on diffraction of X-rays by a ruled grating: A. H. COMPTON and R. L. DOAN. For many years we have believed that X-rays are like light rays but of much shorter wave-length. The most usual method for measuring the length of light waves is by means of a "grating" of lines ruled close together on the surface of a mirror of speculum metal. When light is reflected from such a grating, in addition to the beam directly reflected, there are sent out in different directions "spectra," in which the light is spread into the colors of the rainbow. These are the diffracted rays. From the directions in which these spectra are diffracted one can calculate the wave-length of the light. Many unsuccessful attempts have been made, ever since the time of Roentgen, to measure the wave-length of X-rays by similar reflection from a ruled grating. About twelve years ago, Professor Laue, of Vienna, discovered that the regularly arranged atoms in a crystal would act toward X-rays as the lines on the ruled grating act toward light, spreading the X-rays out into a spectrum. Since he knew about how far apart the atoms in the crystal were, he was thus able to estimate the X-ray wave-lengths. But it remained very desirable to be able to determine the wave-lengths directly in terms of the measured distance between ruled lines on a grating. The chief difficulty which had been met in earlier attempts to get a spectrum of X-rays with a ruled grating was that no X-rays were reflected from the surface of the mirror. Recently, however, we found that the X-rays are reflected from a polished surface if they strike it at a sufficiently fine grazing angle. Making use of this discovery we were able to photograph the spectrum of a beam of X-rays reflected at a fine angle from a grating ruled on speculum metal. Our success in this experiment was due in large measure to the fact that we had available Professor Michelson's remarkable ruling engine, on which the largest optical gratings in existence have been made, for ruling a grating especially adapted to the purpose. Just a few months before our work, Professor Carrara performed at Pisa a series of very similar experiments, which apparently failed only because the gratings which he had available were not exactly suited to the purpose. The immediate result of these experiments is to measure in a more direct manner than ever before the wave-length of the very short X-rays waves. This length is only about three billionths of an inch. The outgrowth of the work will probably be the extension of spectroscopic methods to hitherto unexplored

regions of the spectrum, and a more precise measurement of the distances between atoms and of the charge of an electron.

Direct proof that conduction electrons in metals at ordinary temperatures do not share in the energy of thermal agitation: R. A. MILLIKAN. The laws brought to light by Millikan and Eyring's recent study of field-currents, particularly the entire independence of such currents from cold metals upon temperature and their definite dependence upon temperature in the case of hot metals, constitute direct evidence that the bulk of the conduction electrons do not possess energies of thermal agitation at low temperatures, but that some of them acquire such dependence at high temperatures. The observed laws governing the pulling of electrons from cold metals by intense electrical fields are all interpreted in terms of the conception of conduction electrons as very light atoms of high boiling point which follow the quantum specific heat laws in the dependence of their energies of agitation upon temperature.

Chemical decomposition by collision with activated molecules: FARRINGTON DANIELS. A true unimolecular reaction is thought to be uninfluenced by molecular collision and the actual mechanism of such a reaction is a matter of considerable theoretical interest. Recent investigations indicate that the decomposition of nitrogen pentoxide is truly unimolecular. It is shown that nitrogen pentoxide is not decomposed by the infra-red radiation which it absorbs, and that the short infra-red radiation from the walls of the containing vessel does not bring about the reaction. Although nitrogen pentoxide does not now appear to be decomposed by ordinary molecular collisions, it is decomposed by collisions with molecules which are in a condition of abnormally high energy content. Nitrogen dioxide, when activated by blue light, causes its decomposition. Quantitative measurements show that an energy input somewhat less than the critical increment, calculated from the temperature coefficient of the reaction rate, is sufficient to cause decomposition. The quantum relations and the Einstein law of photochemical equivalence are discussed. The introduction of activated molecules may be accomplished also by mixing a reacting gas, such as hydrogen, with the nitrogen pentoxide. Experiments are shown which illustrate the accelerated decomposition brought about in this way. Collision with activated molecules can not be a factor in the normal thermal decomposition of nitrogen pentoxide, since the rate is only slightly affected by the presence of a solvent and the ultimate cause of the thermal decomposition is still an unsolved problem.

The importance of light for the maintenance of animal life: H. STEENBOCK and E. B. HART. Since 1907 there have been in progress at the University of Wisconsin experiments with various types of animals designed to establish the inadequacy of the usually accepted feeding standards. In this the experiments were unusually successful, but when it came to determine the nature of the deficiency variable and contradictory data were obtained continually up to approximately two years ago. Since then it has become established that the unappreciated vitiating factor was sunlight acting either directly upon the animal or upon its food. Sunlight is indispensable to man and beast in that it is the determinant of the efficiency with which calcium can be assimilated and retained; and calcium is one of the elements which needs to be efficiently conserved because in proportion to the body needs it is not found abundantly in foods and feeds. Sunlight plays this particular rôle by virtue of its content of ultra-violet radiations of approximately 250 to 302 millimicrons in wave-length, but unfortunately these are not present in sufficient degree to provide a wide margin of safety for the animal. As a result we have rickets in the young and poor dentition, restricted lactation, abortion and impoverishment of the skeleton in lime to a dangerous extent in the adult. All of which appears to be of greater importance in animal welfare than has been generally realized. The ultra-violet rays bring their effect through the medium of certain compounds widely distributed in plant and animal tissue so that practically any foodstuff can be "antirachitically" activated. "Make hay when the sun shines" is more than a mere poetic slogan, for hay made in the dark is devoid of rickets preventing properties. However general may be the effect of light upon foods, present indications are that only a very limited number of compounds can be affected. Unsaponifiable compounds of a sterolic nature are especially affected. Cholesterol, for instance, can be "activated" by exposure to light, but subsequent heating again inactivates it and thus the process can be reversed apparently an indefinite number of times. These general observations and deductions are presented not as a complete survey but as a beginning study of the indirect physiological and therapeutical action of light.

The isotopic composition and the atomic weight of terrestrial and meteoric chlorine: WILLIAM D. HARKINS and S. B. STONE. Accurate determinations of the atomic weights of meteoric and terrestrial chlorine indicate that this element has the same isotopic composition in the meteorite as on earth, which is favorable to the hypothesis of Harkins that the percentage of isotopes in elements is determined at least largely by the relative stability of the different types of atoms. The average atomic weight on earth of the meteorites is found by these determinations to be 35.457_8, which indicates 77.13 per cent. of the light isotope and 22.87 per cent. of the heavy, provided the atomic weights of the separate species are exactly 35 and 37. The table listed below gives in parentheses the number of determinations and the values represent the ratio of silver-chloride to silver, found by direct weighing, with the probable errors calculated by the method of least squares.

(7)	Apatite	1.32867_4	$\pm$ 0.0000033
(7)	Wernerite	"	$\pm$ 43
(7)	Hydrochloric Acid	"	$\pm$ 43
(21)	Terrestrial	"	$\pm$ 31

(7) Meteoric	1.32868$_0$	±	47
(28) Meteoric and Terrestrial	1.32867$_6$	±	23
(8) Sodalite	1.32868$_0$	±	67

The separation of chlorine into isotopes (lighter isotope): WILLIAM D. HARKINS and FRANCIS JENKINS. Further work upon the separation of the element chlorine into isotopes has resulted in a decrease of the atomic weight from 35.457 to 35.417 or by four one hundredths of a unit. An earlier separation in this laboratory raised the atomic weight from 35.457 to 35.512, or by .055 units. Thus relative separation thus far attained amounts to about one part in 360, which is by far the largest relative separation obtained by any element.

Distribution of sizes of droplets in emulsions: WILLIAM D. HARKINS and NORVIL BEEMAN. Earlier work of a number of investigators indicated that if an oil is emulsified in water by the use of a soap as an emulsifying agent, the droplets decreased in size as the metal of the soap is changed from sodium to potassium to rabidium and caesium. This result corresponds with the predictions of a certain form of what is known as the oriented wedge theory of emulsions. However, the present work indicates that the distribution curve of sizes is not affected by such a change in the metal ion of the soap, since practically identical curves are obtained when any one of these soaps is used. Furthermore, the distribution curve is almost the same if the emulsion is inverted, that is, if an emulsion of water in oil is obtained by the soap of bi- or trivalent metals. In general the peak in the curve, that is, the largest number of drops of course, is at a size of about 1.5 microns. If a viscous oil is emulsified, the position of the peak is not shifted by many more large drops of oil remaining in the emulsion, so that the interfacial area is greatly reduced, in some cases from 15,000 to 8,000 cm per cu cm of oil. The area occupied per molecule of soap in the interface depends somewhat upon the concentration of the soap solution, but is found in general to be about 40 Ångstrom units of area.

Polymolecular and monomolecular films: WILLIAM D. HARKINS and J. W. MORGAN. Up to the beginning of the present work, no direct measurements had been made upon films on water thicker than a molecule. Monomolecular films are formed readily by putting upon the surface of water an organic substance, the molecules of which contain both a polar and a non-polar group. If the polar group is not present, general experience indicates that the substance will not spread, but it has been found possible by the proper choice of such substances to obtain films which vary in thickness from 40 to 200 Ångstrom units. The remarkable feature about these films is that an almost negligible force is sufficient to compress them until they become about 4 to 6 molecules thick but upon further compression to a thickness of 10 to 20 molecules. They exhibit the same characteristics as monomolecular films except for the fact that they are much more easily compressed. Measurements made upon films composed of mixtures of polar with non-polar molecules indicate that the former form in general a monomolecular film over which the molecules of the latter are spread. Measurements were made upon monomolecular films much thinner than any which have been measured previously. The thinnest films of this type had a thickness of 6 Ångstrom units or 6 x 10^{-8} cm.

The surface tension of water at various temperatures: T. F. YOUNG, P. L. K. GROSS and W. D. HARKINS. While collecting data for International Critical Tables, we perceived the importance of an accurate knowledge of the surface tension of water, for this liquid is the best standard with which to compare many old measurements. When we attempted to employ the many measurements which had been made on water, we found that most of them were known to contain serious errors. Except for a few measurements made at room temperature, there was none which appeared to be entirely dependable. To obtain surface tension values for our purpose, the calculations of several observers were corrected for the mistakes believed to have been made in them. The magnitudes of the corrections were determined with the aid of a value for the surface tension of water at room temperature which has been generally accepted. An equation was derived which represents the results of the new calculations very precisely. In spite of the apparent validity of our corrections and the very good agreement between the recalculated values of various observers, we desired to increase the reliability of our equation. We have made some new determinations by the "capillary rise" method which appear to be very trustworthy. The new measurements made at three temperatures confirm not only our equation for the variation of surface tension with temperature, but the accepted value at twenty degrees Centigrade as well.

The problem of the cerebral cortex: C. JUDSON HERRICK. What is cerebral cortex? No one of the anatomical or physiological criteria hitherto proposed is of itself adequate to define it. Combining the anatomical, physiological and genetic evidence, we are led to the conclusion that cerebral cortex emerged from pre-existing reflex mechanisms of innate and habitual activities in the service of more labile individually acquired behavior patterns. It serves two types of higher function: (1) a tonic function as an activator of lower reflexes and conditioned reflexes; (2) a phasic function as a "decider" between various possible modes of response in an unfamiliar situation. The first type is more primitive than the second. The development of the cortex introduces a new type of mnemonic pattern and a new type of learning, *viz.*, the ability to retain and profit by individual experiences as contrasted with more primitive sorts of learning by repetition and trial-and-error. Cortical functions are delayed reactions which are served by correlation mechanisms which are dissociated in space and in time from the apparatus of immediate response to stimulation of reflex, chain-reflex and (primitive) conditioned reflex type.

American coal balls: A. C. NOÉ. A coal ball is a calcareous or silicious concretion found sometimes in the coal seam and containing plant fragments which are so well preserved that their structure can be studied under the microscope. Such coal balls have been observed since 1835 in England and soon afterwards on the continent. Our entire knowledge of the morphology of coal measure plants has been based on the coal balls of England, France and Germany. No coal balls had been found in America until the writer succeeded in obtaining, in 1922, the first genuine American specimens. These came from Danville, Illinois, and Harrisburg, Illinois. Others were found soon in Calhoun, Richland County, Illinois, and in Streator, Illinois. Other American deposits were discovered in Iowa, Indiana, Kentucky and Texas. These investigations were carried on partly through the granting of a subsidy from the Marsh Fund of the National Academy of Sciences and partly under the auspices of the State Geological Surveys of Illinois and Iowa. The University of Chicago has equipped a laboratory for the preparation of microscopic sections from these coal balls and a number of graduate students have prepared their master's and doctor's dissertations on the study of American coal balls. More than twenty-five different species of fossil plants from American coal balls have been recognized and described, among which the most conspicuous were stems and roots which showed close similarity with living Angiosperms. The conclusion that Angiosperms existed already in the Paleozoic was subject to a keen controversy in which American and English paleobotanists participated. While this question is not yet completely settled to everybody's satisfaction, it has thrown considerable light upon the possibility that Angiosperms might have existed in the Paleozoic or that plants were living at that time showing a tendency towards Angiospermic structure. Since a great deal more American material is in the process of investigation, still more light will be thrown upon this interesting question. Whatever the final outcome of the controversy may be it can be seen at present that a great deal of interesting information about the morphology of carboniferous plants can be drawn from American coal balls and that the science of Paleozoic plant morphology will be greatly enlarged and promoted through the American material and will not be in the future, as it was in the past, a purely European domain.

The direct results of Mendelian segregation: CHARLES E. ALLEN. Much the greater part of experimental genetic work to date has been upon diploid organisms. Such an organism has developed from a zygote formed by the union of two gametes. The gamete nuclei were produced, either immediately (Metazoa) or through the intermediacy of a few-celled sexual generation (seed plants), by two divisions in which the hereditary substances were rearranged and segregated into qualitatively different groups. The exact nature of these two segregating (or reduction) divisions constitutes one of the major problems of cytological and genetic research. The genetic study of diploid organisms affords a very indirect approach to this problem. Somewhat more direct is the study of haploid organisms developed from spores which were themselves formed by the segregating divisions. In a few plants it is possible to recognize and isolate the four spores formed by division from a single mother cell. If these four spores can be germinated, the four resultant plants exhibit the hereditary potentialities which, all present in the spore mother cell, were distributed in consequence of the two segregating divisions among its four descendant spores. *Sphaerocarpos Donnellii* furnishes an opportunity for a study of this nature, because the four spores derived from a single mother cell remain adherent. The present paper deals with the distribution of two pairs of alternative characters (femaleness *vs.* maleness and polyclady *vs.* non-polyclady) among the plants developed from the respective spores of individual tetrads. Without exception, to date the four spores of a tetrad give rise to two male and two female plants; and, in offspring of a cross between polycladous and non-polycladous parents, to two polycladous and two non-polycladous plants. In matings of this nature, the tetrads fall into three classes: (*a*) Two non-polycladous females, two polycladous males; (*b*) two polycladous females, two non-polycladous males; (*c*) one non-polycladous female, one polycladous female, one non-polycladous male, one polycladous male. Of fifty-six tetrads derived from four such matings, thirty-two fell in class *a*, sixteen in class *b*, and eight in class *c*. It is evident that class *c* (four qualitatively different spores in the tetrad) is much less numerous than classes *a* and *b* (in which each tetrad is composed of two classes of spores). The combinations of characters shown by the spores of class *a* are the combinations characterizing the respective parents. The discrepancy between the numbers of tetrads in classes *a* and *b* suggests the possibility of a linkage of some nature between non-polyclady and femaleness on the one hand and between polyclady and maleness on the other.

Insect transmission and host range of aster yellows: L. O. KUNKEL. The aster yellows disease which causes serious annual loss to growers of the China aster has been shown to be spread by the leafhopper Cicadula sexnotata. Several other species of leafhoppers passing freely from diseased to healthy plants do not transmit yellows and no other means has been found by which it can be transmitted. Although very specific as to insect host the disease attacks a wide range of plant hosts. It has been transmitted experimentally through the insect to fifty different species in twenty different families of plants. Great variation in symptoms is shown by the disease in its different host plants. Several obscure diseases such as "bunchy top" of the straw flower, yellows of several garden plants and the "Rio Grande" or "rabbit-ear" disease of lettuce have been shown to be identical with aster yellows and to be transmitted to these plants by the aster leafhopper. Peach yellows, though similar to aster yellows, is not related to it etiologically. No evidence has been found that the virus of aster yellows causes disease in its insect host.